wennovate

D5.2
4 Joint Action plan

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WEnnovate partners

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1. Executive Summary: National action plans for Europe's digital energy transition

This document, incorporating the 4 National Action Plans from Slovakia, the Netherlands, Hungary and Ukraine, represents a final deliverable for the WEnnovate project and builds on 12 months of extensive research and stakeholder engagement regarding each country's, and the EU's, ongoing clean energy transition. The project and these action plans place a significant emphasis on the key role digitalisation and innovation, both technological and social, has to play in ensuring the energy sector is equipped to navigate the challenges of the ongoing climate crisis and the broader socio-economic, geo-political, and technological transitions we are experiencing spanning local contexts through to a global scale.

These Action Plans build on other WEnnovate deliverables that lay out the key challenges and opportunities for the partner regions (D3.1 and D3.2), and build on initial recommendations (D5.1) gathered throughout the project. This deliverable should be read in conjunction with D5.3 Joint long-term programme plan (incl. Resource and Activity allocation plan).

Framing the transition

The WEnnovate project has highlighted significant discrepancies in the progress, context and alignment of ambitions for the green digital energy transition across partner countries, underlining the different challenges each face, as well as numerous areas for synergies and shared learning. Fundamentally, the project has flagged the overarching importance of a transition plan that is built on a positive and ambitious vision for the future of the energy system that is not constrained by the context of today's existing challenges, but one which addresses the root causes for these obstacles. A key element of this is the understanding that digitalisation, and the clean transition of the energy system, cannot be viewed as separate concepts, and that they are intrinsically linked. It is also essential to note that this transition cannot be solved by technological innovation alone, and that this transition is also fundamentally social, with the awareness, education, engagement, and collaboration of users, citizens, and stakeholders across the ecosystem the key to unlocking the level and nature of social and technological innovation that will form the foundation of a sustainable transition.

Progress towards the clean digital energy transition

The current landscape of digitalization in the energy sector across the EU reveals a significant gap between strong tailwinds driving digitalisation and the roll-out of renewable energy at an EU level, and amongst leading regions in the transition, and countries with more conservative and reactive approaches to the transition, demonstrating limited political commitment and progress in implementing and supporting the required changes. Across all partner regions, there is a strong need

for coherent, and consistent strategic vision setting that combines the needs of the digitalization and clean energy transitions within a single integrated framework.

On the business side, digitalisation brings the **potential for enormous upside.** Embracing digital technologies like IoT, smart metres, and data analytics can unlock substantial benefits, including improved grid reliability, enhanced energy management, and greater consumer participation in energy markets.

In this document, to be read in parallel with "D5.3 Joint long-term programme plan (incl. Resource and Activity allocation plan)", we propose numerous actions at a National level, for each of our partner ecosystems to drive the Digitalisation of the Energy Sector, thereby delivering on a comprehensive, agile and robust strategy for sustainable energy transition. These incorporate the following key pillars:

Policy & Regulation: A robust framework and clear direction is proposed to streamline digitalisation, local renewable energy integration, and decarbonization efforts, with ambitious targets for greenhouse gas reduction and renewable energy adoption by 2030, and an increasingly digital society.

Market State & Funding: The actions emphasise the need for significant investment in green digital energy infrastructure, particularly around reducing barriers to existing funding and supporting international collaboration

Human Capital: Recognizing the importance of a skilled workforce, the plan includes initiatives for training, education and management of a digitally proficient, clean energy sector workforce. It also highlights the importance of public awareness and advocacy as key drivers for championing transitional change and building trust for new digital & clean technologies.

Technology Adoption & Deployment: The strategy prioritises the rapid deployment of digital green technologies, with key considerations on interoperability of digital energy devices, maximising efficiency, promoting innovation and AI adoption across the energy landscape. Adoption of favourable legislation for the deployment of energy communities is also essential to reduce capacity pressures on distribution networks. There is a delicate balance required between driving innovation and favouring readily available 'non-innovative' solutions that bring more immediate benefits in the transition, particularly to stressed ecosystems. Whilst all partner countries have seen strong progression in at least one or more renewable energy source, maintaining this progress and accelerating integration of other green technologies (i.e. offshore wind, carbon capture and storage, hydrogen etc.) is key and will require the necessary infrastructure capacity, storage mechanisms, and system optimisation to enable it.

Ecosystem Connectivity: Collaboration is at the heart of a successful transition and driving cross-sector, quadruple helix synergies and knowledge exchange will be key for a highly innovative ecosystem that creates a future digital energy system that benefits all.

Resilient Growth: The plan aims to balance energy security, affordability, and sustainability, ensuring a just transition that supports economic growth while meeting climate objectives and enhancing not only national but also regional and local energy independence. Resilience also incorporates a unified, sector-wide digital and data approach and clear action on cybersecurity strategy and assessment to guide stakeholders across the ecosystem.

A proactive digital, clean energy transition is essential for the EU and its member states, not only for meeting environmental goals and aligning to EU obligations, but also for fostering innovation and economic growth as a competitive single market, and securing cheaper, more reliable energy for the population in the coming years. To achieve this, WEnnovate's partner nations must prioritise the development of an integrated framework that aligns digitalization efforts with energy transition objectives, and drives strong awareness and collaboration on the transition's key challenges, both nationally and internationally.

2. National Action Plans: Introduction

2. 1 WEnnovate background and context

This document, D5.2. National Action Plan(s), has been prepared as part of the EU-funded WEnnovate project (Full title: *Connecting Minds, Powering Change.*; Ref #: 101134909).

The WEnnovate project is a 12-month initiative aimed at accelerating the European Union's transition toward a clean, digital, and localised energy system. At its core, the project highlights the essential role of interconnected, inclusive, and efficient innovation ecosystems in enabling this transformation. It focuses on the interdependence of energy and digital transitions, stressing the need to co-create solutions that transcend national borders while addressing critical priorities such as environmental sustainability, digital innovation, social inclusion, economic resilience, and regulatory alignment.

Collaboration across local, regional, national, international, cross-disciplinary and quadruple helix levels is central to achieving a successful digital energy transition. WEnnovate places significant emphasis on co-creating its outputs with key stakeholders while creating an inclusive atmosphere to engage contributors traditionally underrepresented in the digital and energy ecosystems. This approach ensures a more holistic and participatory framework for advancing the transition.

Operating at the intersection of extensive research and policy development and significant stakeholder engagement, WEnnovate addresses both the "why" and "what" of the energy transition, drawing on existing and emerging EU, national, and regional strategies, such as the EU's Action Plan on Digitalising the Energy System, and the New European Innovation Agenda amongst others. It then goes a step further to consider the "how", tackling practical implementation challenges. Within this context, the project seeks to bridge two critical gaps: the need for greater coherence and consistency in digital energy transition requirements across governance levels, and the absence of a detailed implementation roadmap to support an innovative transition.

By tackling these challenges, WEnnovate provides practical guidance on translating strategies into action, defining clear responsibilities, and fostering the collaborations needed to drive meaningful progress. Ultimately, the project seeks to deliver a robust framework to support the EU's vision for a safe and sustainable, interconnected, and secure digital energy future.

This Action Plan(s) and the Joint programme plan represent two of the final outputs of the WEnnovate project, building on wide stakeholder engagement, and research and analysis to deliver an informed view on priorities for the partners' respective digital energy transitions.

2.2 Purpose and objectives of the Action Plan(s)

Each of the four Action Plans within D5.2 share common goals and desired outcomes, serving as roadmaps for the digital energy transition at a national level. These plans build on the growing consensus among stakeholders and institutions regarding the needs and strategic direction for the transition—the "Why" and "What" outlined in the Ecosystem Analysis sections of this document.

The Action Plans go beyond defining the rationale and objectives by establishing the foundation for the "How" and "Who". They address the critical bottlenecks currently impeding progress, providing guidance on where to start, which actions to prioritise, and identifying responsible parties and necessary collaborations. A key element of this framework is offering targeted support and guidance to stakeholders across industry, academia, and public authorities, and civil society, ensuring that all actors are equipped to contribute effectively. These plans are designed to act as platforms for advancing actionable steps and translating strategies into tangible implementation.

Recognizing the need for cross-disciplinary and cross-sectoral collaboration, the development of these Action Plans emphasises fostering stakeholder alignment and creating opportunities for new regional, national, and international partnerships. Additionally, they aim to unlock funding opportunities essential for driving the transition forward.

Ultimately, the Action Plans are intended to enable a fair and inclusive green and digital transition, placing innovation—whether technological, commercial, or social—and collaboration at the heart of this transformative process.

2.3 Defining the scope

The Energy transition is a critical imperative for the European Union, its Member States, and nations worldwide. This urgency stems from the intensifying climate crisis[1], the imperative of decarbonization, growing energy and critical raw materials demands, and heightened geopolitical tensions, notably the ongoing conflict in Ukraine. The energy sector occupies a strategic position in addressing these global megatrends, requiring systemic changes and a comprehensive transformation of current energy systems—where digital, renewable, and social dimensions must be integral components[2].

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[1] IPCC. (2021, August 9). Climate Change Widespread, Rapid, and Intensifying. The Intergovernmental Panel on Climate Change. https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/

[2] Nazari, Z., & Musilek, P. (2023). Impact of Digital Transformation on the Energy Sector: A Review. Algorithms, 16(4), 211. https://doi.org/10.3390/a16040211

The social elements of the transition have a key role in enabling other components of the transition and have been targeted as a cornerstone of the WEnnovate project. This social dimension encompasses major challenges, from public engagement, acceptance and trust in the Transition, skill development and workforce adaptation, behavioural and societal changes, inclusive policy making, and increased support for and uptake of collaboration opportunities[3].

The energy transition presents a wide range of challenges spanning the energy sector itself—including production, conversion, transmission, distribution, storage, consumption, and market dynamics—as well as related priority sectors such as industry, transport, and buildings. To effectively address these challenges, the WEnnovate project has focused its investigations and proposed actions on cross-cutting topics that serve as key enablers for the transition.

Digitalization of the energy system is viewed as an essential cornerstone in achieving Net Zero goals[4]. While acknowledging the broader scope of actions needed to support these ambitions, WEnnovate concentrates primarily on initiatives that simultaneously advance the digitalization and innovation agenda. This focused approach aims to ensure that digital technologies are leveraged effectively to drive the energy transition.

Within the context of the digital energy transition, key technical enablers include optimising the energy mix—particularly through the integration of renewable energy sources (RES) into smart grids, addressing associated capacity and connectivity challenges, and advancing the deployment of distributed digital assets. Centralised data governance, a robust regulatory and policy framework, active consumer and workforce participation, enhanced knowledge and skills, and strengthened energy security and resilience are also pivotal to the success of this transformation.

[3] Zhou, S., Zhang, F., Wang, Y., & Shao, Z. (2023). Literature review and analysis of the social impact of a just energy transition. Frontiers in Sustainable Food Systems, 7. https://doi.org/10.3389/fsufs.2023.1119877
[4] IEA. (2023). Digitalisation - Energy System. IEA. https://www.iea.org/energy-system/decarbonisation-enablers/digitalisation

2.4 European ambitions for the digital energy transition

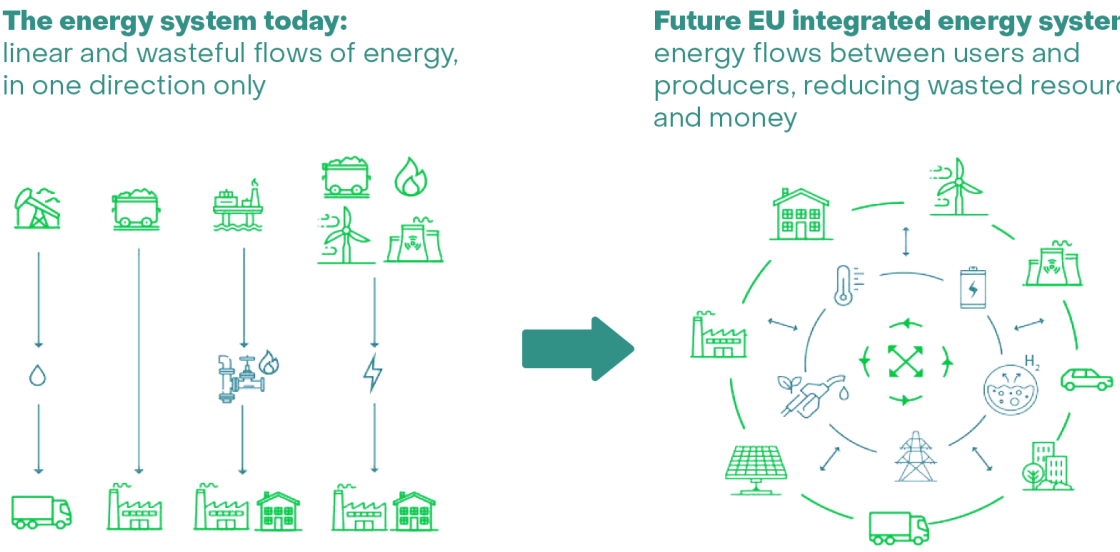

Fig.1 Transition to Future EU integrated energy system

The European Union has embarked on an ambitious plan to digitise its energy system, aiming to transform the region into a smarter, more interactive, and sustainable energy environment. By 2030, the EU aims to reduce greenhouse gas emissions by 55%, increase the share of renewable energy to 45%, and significantly expand its renewable energy capacity. The EU's strategy includes increasing wind and solar power generation capacity from 400 GW in 2022 to at least 1,000 GW by 2030. Additionally, the region is set to deploy over 320 GW of solar-photovoltaic capacity by 2025 and nearly 600 GW by the decade's end. Offshore renewable energy will also grow, with plans to reach 317 GW[5].

To navigate the complexities of this digital transition, the EU published the Digitalising the Energy System - EU Action Plan (COM/2022/552)[6]. Further, the EU has introduced a series of policy measures and directives. These include revisions to existing frameworks such as the Renewable Energy Directive (REDIII), the Energy Performance of Buildings Directive (EPBD), and the Energy Efficiency Directive (EED). New regulations like the Alternative Fuels Infrastructure Regulation (AFIR) have also been implemented.

[5] Digitalisation of the European Energy System | Shaping Europe's digital future. (n.d.). Digital-Strategy.ec.europa.eu. https://digital-strategy.ec.europa.eu/en/policies/digitalisation-energy

[6] EUR-Lex - 52022DC0552 - EN - EUR-Lex. (2022). Europa.eu. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0552&qid=1666369684560

Recent additions such as the Wind Power Package and the Grid Package further support these objectives[7].

To accommodate this increase in renewable energy, the EU plans to modernise its energy infrastructure. This includes the development of smart grids, which will enhance efficiency, reliability, and security, while supporting the integration of variable renewable power into electricity networks. Notably, the modernization will focus on creating a decentralised energy mix, making the system more resilient and less reliant on centralised fossil fuel sources.

The transition to a decarbonized energy system requires a multifaceted approach. This includes accelerating flexibility measures to match the pace of renewable energy deployment, ensuring that both supply and demand can adapt to changing conditions. It also calls for deeper integration between different sectors, increased consumer engagement, better utilisation of assets for demand-side flexibility and adequacy services, enhanced energy trading across all markets, and the development of a more innovative and enabling regulatory framework. Successfully integrating this flexibility into the system will allow for significantly increased competitiveness of the EU on a global scale, with the economy built on the foundations of a more agile, scalable energy system.

Digitalization is critical to achieving these goals. The European Commission is promoting the use of advanced technologies such as the Internet of Things (IoT), smart metres, 5G and 6G networks, cloud-edge computing, and digital twins of the electricity system. These technologies will optimise energy consumption, enhance grid management, and support the integration of renewable energy. They also necessitate due care and considerations for requirements on cybersecurity, consumer data and privacy, interoperability and much more. A key pillar of this effort is the creation of a pan-European energy data space, which will facilitate data sharing among stakeholders. This data infrastructure is expected to drive innovation in energy services and improve market participation.

To meet its ambitious targets, the EU estimates that €584 billion will be required for investments in the electricity grid by 2030, with a significant focus on digitalization. This includes building the necessary

[7] Directorate-General for Energy (European Commission, DNV, E3M, LBST, Schönherr, Trinomics, Lise, W., Ansarin, M., De Haas, V., Bene, C., Gorenstein Dedecca, J., Henriquez, E., Krishnappa, H., Aslanoglou, M., Kavvadias, K., Capros, P., Altmann, M., Diehl, L., Lust, F., & vom Scheidt, F. (2024). Study on promoting energy system integration through the increased role of renewable electricity, decentralised assets and hydrogen: final report. In Publications Office of the European Union. Publications Office of the European Union.
https://op.europa.eu/en/publication-detail/-/publication/316e479f-39b1-11ef-87a1-01aa75ed71a1/language-en?WT_mc_id=Searchresult&WT_ria_c=37085&WT_ria_f=3608&WT_ria_ev=search&WT_URL=https%3A//energy.ec.europa.eu/

infrastructure to support the deployment of 10 million heat pumps and 30 million zero-emission vehicles by 2030[8].

The concept of a Digital Spine has been introduced to help close the investment gap by utilising advanced digital technologies[9]. By facilitating decentralised intelligence between sectors, the Digital Spine improves the sustainability and efficiency of current infrastructures. This approach helps optimise renewable energy usage across various sectors, thereby reducing the need for massive investments in physical infrastructure.

The Digital Spine also seeks to enhance communication and standardisation across digital infrastructures, particularly where different sectors intersect. By simplifying the deployment of renewable energy and enhancing energy flexibility, this strategy aims to advance sustainability goals while ensuring Europe's long-term economic competitiveness.

Despite these advancements, several challenges persist in the digitalisation of the system and the integration of decentralised renewables. These barriers can be categorised into four main areas:

1. Technical challenges: These include insufficient expansion and reinforcement of distribution networks, delays in smart metre deployment, inadequate digitalization at the distribution level, and prolonged grid connection and permitting processes.
2. Economic and financial hurdles: High upfront costs for equipment and installation, as well as ongoing operational expenses, pose significant barriers to adoption.
3. Legislative and regulatory issues: The need to adjust regulations at the national level to align with EU directives and goals presents a complex challenge.
4. Societal factors: A lack of professional experience and skills in the renewable energy sector, coupled with limited consumer awareness and knowledge, hinders widespread adoption.

As the energy system becomes more digital, the EU is placing a strong emphasis on cybersecurity. New rules are being introduced to protect the electricity and gas networks from physical, cyber, and hybrid attacks. The NIS2 Directive will be key to safeguarding energy infrastructure, while additional measures will ensure resilience against potential threats. Consumer empowerment is also a priority, particularly for vulnerable populations. The digitalization of the energy system will provide consumers with better access to energy services, helping to protect them from price volatility and energy poverty.

In conclusion, the EU's digital energy transition is a cornerstone of its broader climate and sustainability ambitions, blending technological innovation with policy frameworks to achieve a decarbonized,

[8] Press corner. (n.d.). European Commission - European Commission. https://ec.europa.eu/commission/presscorner/detail/en/QANDA_22_6229

[9] Accelerating the green transition: the role of digital infrastructures in decarbonising energy and mobility sectors. (2024, July 10). Shaping Europe's Digital Future. https://digital-strategy.ec.europa.eu/en/news/accelerating-green-transition-role-digital-infrastructures-decarbonising-energy-and-mobility

resilient, and consumer-centric energy system. The EU not only aims to meet its renewable energy and emission reduction targets but also to position itself as a global leader in sustainable energy innovation. This ambitious vision promises a cleaner, more efficient energy future that benefits all segments of society while ensuring Europe's long-term competitiveness on the world stage.

Ukraine's ambitions for the digital energy transition are closely aligned with those of the European Union, particularly in the context of post-war recovery and integration into European energy markets. Following the disruptions caused by the ongoing conflict, Ukraine has recognized the necessity of modernising its energy infrastructure to enhance resilience and sustainability. This includes adopting digital technologies that facilitate the integration of renewable energy sources and improve overall energy efficiency. Ukraine aims to leverage advanced digital solutions such as smart grids, IoT devices, and data analytics to optimise energy consumption and management across its grid. By aligning its digital energy strategies with EU initiatives, Ukraine not only seeks to secure energy independence but also to contribute to the EU's broader goals of reducing greenhouse gas emissions and increasing renewable energy capacity. Collaborative efforts, such as participation in EU-funded projects and adherence to European regulatory frameworks, will be essential for Ukraine to effectively transition towards a decarbonized and digitally-enabled energy system, fostering both national growth and regional stability[10] [11] [12].

[10] Digitalisation: An enabler for the clean energy transition. (n.d.). https://www.epc.eu/content/PDF/2023/Vodafone_DP_FINAL.pdf

[11] Ionan, V. (2024, October 18). Ukraine sets example for EU on digital integration. The Parliament Magazine. https://www.theparliamentmagazine.eu/news/article/oped-ukraine-leads-the-way-on-digital-integration-with-the-eu

[12] Union of Entrepreneurs and Employers. (2024). Position paper on Ukraine digital policy. Retrieved from https://ppl-ai-file-upload.s3.amazonaws.com/web/direct-files/35342964/d815fb03-6144-4e60-aa56-41cfee228384/Position-paper-on-Ukraine-Digital-Policy.pdf

2. 5 Methodology & development process

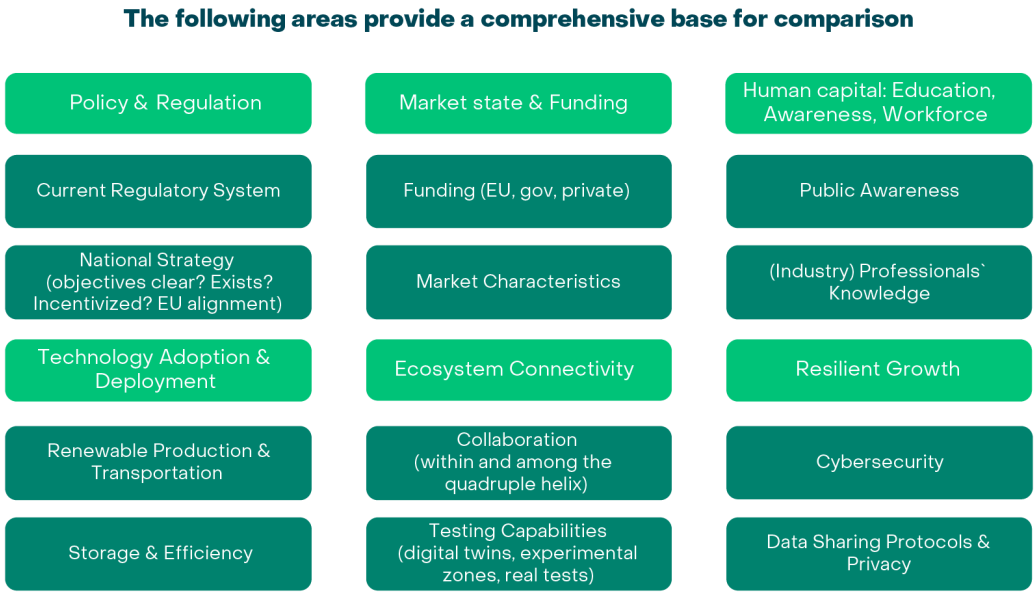

Fig. 2: WEnnovate's framework for the digital energy transition

The WEnnovate project employed various models and processes throughout the project's lifecycle, with the primary model that guided the stakeholder engagement and analysis phase of our work (Fig. 2) informed by other leading transition and digital energy frameworks. Two of the primary influences which the project drew on were the X-curve framework developed by Dutch Research Institute for Transitions (DRIFT), (based on Loorbach et al. 2017) (Fig. 4) for transition management and DG ENER's framework for digitising and decarbonising the energy sector (Fig. 3).

Fig. 3: Priorities from "Digitalising the Energy System—EU Action Plan"

Transition model: The WEnnovate project approached the challenge of addressing the digital energy transition through the lens of the X-curve framework (Fig 3.), as developed The Dutch Research Institute For Transitions. Rotterdam, The Netherlands[13]. The model emphasises the importance of a participatory process to ensure justice and sustainability, and the role of not just technology, but also social innovation within a transition, an essential pillar of WEnnovate's approach.

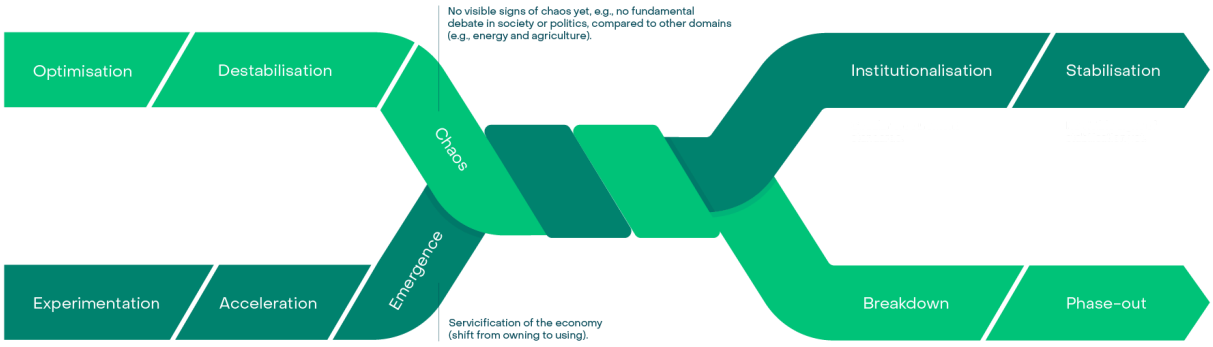

Fig. 4 - WEnnovate's adaptation of the X-framework developed by DRIFT

Within the model's "X-curve", the energy system is currently at the "chaos" state, an inflection point on the verge of systematic breakdown and rebuilding, with old and new systems coming to a head.

[13] drift. (2024, February 24). Transitions • DRIFT. DRIFT. https://drift.eur.nl/en/about-drift/transitions/

Incumbent players are able to thrive within an regulatory and social ecosystem that still supports the old system (i.e. tariff models and market subsidies that dissuade innovation or change from the centralised energy model) whilst local governments, end-users and new players are calling for new legislation and support that favour the incoming decentralised system (i.e. energy sharing and flexible grid connectivity). This is a picture reflected across the EU, with all Member States, regardless of their degree of transition maturity, experiencing significant differences in transition ambitions (scale and speed) between sector stakeholders. Particularly within the WEnnovate partner countries, whilst a growing force, those in favour of a rapid transition in line with the EU's ambitions remain a relatively limited community.

Stakeholder engagement and research

The 4 national action plans are the product of extensive stakeholder engagement across the four regions, with a total of 408 stakeholders engaged throughout the dialogue and co-creation process, and 32 multi-stakeholder co-creation and planning meetings complementing the direct engagement with ecosystem representatives.

Overall, the resulting actions were developed through a combination of desktop analysis, interviews, surveys, and multi-stakeholder workshops. The actions within the National Action Plans include contributions from third-party stakeholders aligned with WEnnovate's research and priorities, as well as consortium-led initiatives seeking suitable partners. These national-level investigations further form the basis for the Joint Programme, a document outlining alignment on shared priorities.

The creation of the National Action Plans incorporated a collaborative and inclusive approach, with the consortium partners engaging key stakeholders throughout the entire process through the above mentioned interviews, multi stakeholder workshops, as well as review sessions. The identified actions thus come from the engagement of diverse stakeholders and remain open to broader support from third parties. By engaging key stakeholders, the consortium partners strived to understand the current state of the digital energy transition and activities started or planned within this realm to build on and fortify existing efforts.

As for the aspect of inclusivity within the project's approach, the digital energy transition's complexity and far-reaching impact across all aspects of society and the economy necessitates a diverse and representative stakeholder perspective to develop solutions that are both inclusive and broadly implementable. Thus, guided by the DRIFT methodology, WEnnovate emphasised both technological and social innovation, framing its work around the quadruple helix model to ensure inclusive and equitable measures leading to just outcomes:

- **Academia:** Universities and research institutions contributing expertise.
- **Industry:** Energy companies, technology providers, and startups driving innovation.
- **Government:** Authorities providing policy and regulatory support.
- **Civil Society:** Consumers and communities representing societal needs.

Furthermore, special focus within the diverse set of stakeholders was placed on engaging underrepresented groups, including actors such as new market entrants and female leaders, to ensure a diverse and inclusive energy transition.

2.5.6 Actions overview & Disclaimers

The actions within these National Action plans have been identified as critical next steps for Slovakia, the Netherlands, Hungary, and Ukraine's digital energy transition. These actions were selected based on several factors, including their alignment with strategic priorities and opportunities for the transition, as well as the level of existing stakeholder support and the availability of funding.

It is important to note that the proposed actions vary in their level of maturity (Action Status). Further work will be required by both the WEnnovate project team and other ecosystem stakeholders to refine, evaluate, and advance the actions outlined. While no specific impact assessments have been conducted for these actions at this stage, it is anticipated that such evaluations will form part of any future funding applications or support proposals for individual actions.

As previously highlighted, these National Action plans have been designed in parallel with the creation of a Joint Programme (D5.3) which incorporates common priorities and collaboration opportunities from across all partner regions. As a result of this, and to avoid repetition, overlapping actions originally targeted at the National Plans, have been removed and included only within the Joint Programme. As such it is important for National stakeholders to consider these documents together. To support this at the start of each National Plan's Action section, a brief overview of the National and Joint action titles is included to provide this holistic view.

This list is not intended to be exhaustive. Ongoing analysis and stakeholder engagement, both during and beyond the project's duration, will continue to refine the priorities and shape the proposed next steps. Additionally, it is recognized that some challenges and recommendations highlighted in D3.2 and D5.1 may not yet have a corresponding action assigned. In such cases, further investigation will be required to identify appropriate responses.

Disclaimer on Stakeholder Inclusion

The inclusion of named stakeholders in this action plan serves as an expression of interest in future collaboration and is a direct result of the extensive stakeholder engagement process. It does not represent a binding commitment by any stakeholder to undertake or participate in the actions outlined, irrespective of funding outcomes. Stakeholder participation will be re-evaluated at the time of application for future funding opportunities, considering factors such as funding availability, specific call

requirements, and the availability and capacity of consortium members. All engagements are subject to formal agreements to be established during the implementation phase. Beyond the stakeholders specified within the action descriptions, extensive outreach and discussion on action collaboration is ongoing and will be incorporated into future submissions.

2.6 Structure of the Document

The National Action Plans begin with an Ecosystem analysis for each state, outlining key problems and recommendations, as structured following the WEnnovate's framework for the digital energy transition introduced above (Fig. 4). The Actions Overview then presents the proposed actions following the same structure. While most of the section is dedicated to the overview of the actions that are part of the National Action Plans, we reference the Joint Programme by providing a list of actions prioritised for the latter document. Since some of the actions were excluded from the National Plans given their nature of transborder importance and the suitability of an international cooperation approach, we provide the list of joint actions outlined in the Joint Programme document to give a full overview of the totality of activities identified within WEnnovate's activities, whether they are driven nationally or internationally. For more details regarding the Joint Programme actions, please refer to D5.3 Joint long-term programme plan.

Concerning the structure of the actions themselves, they are formatted within individual action cards, outlining the details of each action, their objectives, key stakeholders, funding, and background information. While each initiative can function as an independent action or project for future funding, they have been deliberately designed to complement one another. The overarching goal of the National Action Plans is to address as many of these initiatives as possible thereby facilitating these synergies. Whilst a core structure was agreed upon to ensure consistency, each National Plan has been able to adapt this structure to best fit the needs of their ecosystem stakeholders.

The National Action Plans are intended to function as dynamic, evolving documents. They will be continuously updated and overseen by WEnnovate project partners even after the project's conclusion to support the implementation of the outlined target actions, as detailed in the Monitoring and Evaluation section.

3. Slovakia

3.1 Slovakia Ecosystem Analysis: Key Problems & Recommendations

As outlined above, Slovakia's shift toward a digital energy ecosystem is challenged by complex, interconnected issues in regulatory frameworks, market funding, human capital, technology deployment, and resilience. Addressing these problems comprehensively is essential to create a dynamic, secure, and sustainable energy sector. This section offers an analysis of the primary challenges across these domains, linking each with targeted actions and recommendations.

3.1.1 Policy & Regulation

Fragmented strategies and barriers to implementation

The Slovak energy sector's strategic landscape is hindered by a **multitude of isolated strategies**, while the **effectiveness of their implementation** is being questioned, with a lack of resources and clear ownership key challenges. At the same time, despite numerous existing action plans, there is no comprehensive strategy **integrating green energy with digitalization,** with digital energy occupying a largely marginal space in the current political debates. The Slovak National Energy and Climate Plan (NECP) has the potential to fulfil this role, and thereby avoid the creation of yet another action plan or strategy, however will require a greater focus on integrating digital considerations, more ambitious climate targets, and an emphasis on practical, integration-focused recommendations. See Action 1.

Regulatory barriers and slow legislative change

Regulatory frameworks present barriers to innovation adoption. Current **permitting processes** and regulatory structures, such as the "G component" **tariff**, a regulatory cost that burdens projects, and other network fees slow down or block new energy innovations, making it difficult for **new market entrants** (i.e. energy communities) to introduce digital energy solutions[14]. Notably, Slovakia has recently been cited by the European Commission for failure to implement the EU's Renewable Energy Directive (RED III) on time which is indicative of a regulatory and legislative system that is consistently slow to incorporate EU legislation on the digital energy transition into the National ecosystem, with an ongoing

[14] European Commission (2022) Country Report – Slovakia, Accompanying the document Recommendation for a Council Recommendation on the 2022 National Reform Programme of Slovakia and delivering a Council opinion on the 2022 Stability Programme of Slovakia. https://commission.europa.eu/system/files/2022-05/2022-european-semester-country-report-slovakia_en.pdf

approach that often aims only to **satisfy the bare minimum EU regulatory requirements**, undermining proactive leadership in the sector[15]. Several mitigation measures have been identified within Slovakia's Recovery Plan, namely, in the REPowerEU chapter, however, political will for the required changes remains limited at a public authority level, and more broadly across the quadruple helix. Given the **politically driven** nature of the changes required, and the fact that the key regulatory and legislative barriers have been well documented, key mitigations in this space should focus on increasing **awareness and advocacy** on the needs, benefits and opportunities of increased, digital, renewable energy integration (see Action 1.) and clear governance structures to drive these changes (i.e. oversight committees, regular reviews etc.).

The role of compelling advocacy is essential across all elements of the digital energy transition (strategy, regulation, funding etc.) and pressure must be delivered both top down (via EU Commission mandates and directives), and bottom up (coordinated efforts combining both industrial associations, civil society, consortia of quadruple helix stakeholders, non-profits etc.) given the weight of **competing interests** and historic support for sectors like nuclear and fossil fuels. See Action 1.

3.1.2 Market and Funding

A key market challenge in driving digitalisation and innovation of Slovakia's energy system is the current energy price subsidy system in place. Current government support ensures consumers have amongst the lowest electricity prices in Europe however this stifles the demand for optimisation and efficiency gains, key benefits offered by digital, smart solutions, thereby creating a hugely challenging environment for energy innovators to navigate.

Insufficient funding opportunities restrict digital energy projects[16]. The limited availability of funds, both at the national and EU levels, poses a major obstacle. Slovak companies face significant competition for EU grants, while national programs are limited in size, **inaccessible** due to **complex administrative** application processes, and have a track record of **burdensome** implementation and reporting requirements which dissuades national applicants. Despite the fact that significant efforts have been made to improve the level of market consultation involved in call preparation, aligning to market needs, and the presence of National Agencies and other bodies to support with applications for National Funding (SIEA, VAIA, sector associations, EDIH networks, etc.), the resource cost (time, money, and process) of national funding is still a significant barrier for innovative SMEs compared to larger organisations, thereby restricting the innovation potential of the market. See Action 1.

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[15] European Commission. (2023). Press corner. European Commission - European Commission. https://ec.europa.eu/commission/presscorner/detail/en/ip_23_163

[16] Energy Saving Trust. (2024, November 6). Our response to barriers to community energy projects call for evidence. Energy Saving Trust. https://energysavingtrust.org.uk/report/barriers-to-community-energy-projects-response/

Creating dedicated funding channels to lower entry barriers for smaller organisations, particularly in renewable energy projects, would also increase project participation[17]. A national public-private partnership initiative could be considered to pool resources from the state and industry, ensuring that emerging projects can access sustained funding.

3.1.3 Human Capital

Slovakia's digital energy transition faces a four-fold challenge in the topic of Human Capital: (1) Low engagement and example-setting on the opportunities of the digital energy transition amongst political, industrial and other strategic leadership, (2) low public and industrial awareness of the need and upsides for the transition, (3) low technical workforce capacity to implement the needed changes (effective knowledge exchange, talent development, acquisition, and retention), (4) an educational and upskilling system not suited to the future needs of the digital energy system.

Slovakia's political and industrial leadership in this digital energy innovation space can be characterised by a **risk-averse** mindset, with institutions largely prioritising **stability over innovation**, and not driving climate change and digital energy as pressing priorities. This approach then has a trickle-down effect, causing the same indifference to the needs of the transition amongst the broader workforce and civil society. Change management and clear communication of the diverse benefits of the transition will be essential to shift this institutional culture towards one of greater openness to innovation and climate priorities. See Action 1 and 4.

This challenge is compounded by high public **support for nuclear** energy, with 70% of the Slovak population convinced the country needs nuclear power plants[18] which latently creates resistance to other RES and widespread **misconceptions and misinformation** on the impacts of the green digital energy transition, particularly around costs, safety and security. Again, awareness and public education (success stories, practical benefits, how-to guides and support etc.), and transparent, inclusive planning (across the quadruple helix) for a Slovakian energy system fit for the digital age will be essential in driving engagement and support from society. See Action 4.

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[17] IEA. (2021). Financing Clean Energy Transitions in Emerging and Developing Economies World Energy Investment 2021 Special Report in Collaboration with the World Bank and the World Economic Forum. https://iea.blob.core.windows.net/assets/6756ccd2-0772-4ffd-85e4-b73428ff9c72/FinancingCleanEnergyTransitionsinEMDEs_WorldEnergyInvestment2021SpecialReport.pdf

[18] Slovenske elektrarne (2022). Support for nuclear energy in Slovakia has increased significantly, seas.sk, https://www.seas.sk/en/press-releases/growing-support-for-nuclear-energy-in-slovakia/#:~:text=As%20many%20as%20seven%20out,on%20the%20rise%20among%20Slovaks.https://www.seas.sk/en/press-releases/growing-support-for-nuclear-energy-in-slovakia/#:~:text=As%20many%20as%20seven%20out,on%20the%20rise%20among%20Slovaks.

The challenges of a workforce fit for the digital and green energy transition have been well documented, ranging from **international brain drain**[19] , an incoming workforce **disinterested and unaware** of the opportunities in the energy sector, a lack of specialised roles working on breakthrough areas, with other countries leading the transition, strategic planning and policy execution gaps, and a lack of practical skilled-workers to implement the required changes. This challenge spans both formal and informal education, capacity building and awareness activities, designed at both an executive, intermediate and pre-workforce level. Cross-sectoral approaches and learnings on talent management and upskilling are limited and disjointed and need to be scaled in a coordinated manner, to access broader demographics (see Action 2-3). It is essential that all stakeholders participating in knowledge sharing and upskilling initiatives support the ongoing flow and dissemination of information via their own channels (i.e. between government departments, or from central authorities out to municipalities), as this is currently not widely done, with limited awareness of relevant information channels, limiting stakeholders' ability to share knowledge and act on it effectively.

The effective integration of digital energy workforce requirements into the formal education system faces numerous challenges from a lack of existing aligned, and specialised pathways, and challenges related to course development, delivery and accreditation, with high barriers of entry for new courses and materials preventing the latest emerging topics being incorporated into the system in a timely manner. Additionally, existing programs are heavily theoretical, with academia-industry integration still in development, and students are more drawn to other sectors such as IT rather than energy. See Action 2.

3.1.4 Technology Adoption & Deployment

All the challenges mentioned above directly impact the rate of implementation, adoption and deployment of digital, renewable energy technologies within Slovakia. Whilst significant efforts are being made to drive improvements in certain fields (e.g. energy efficiency and public building renovation), there are other fields that remain nascent and far behind international partners regarding digital, renewable ecosystems (energy communities, EV infrastructure and smart device integration, grid balancing and energy storage etc.).

A commonly cited challenge is the lack of grid capacity and connectivity to support advanced digital energy infrastructure[20]. Slovakia's grid lacks the necessary capacity and modern infrastructure (such as

[19] Diaz, J. A. (2024, January 29). The emptying out of rural areas and the accompanying brain drain are fuelling inequality in the EU's most depopulated regions. Equal Times. https://www.equaltimes.org/the-emptying-out-of-rural-areas?lang=en

[20] Fuergy. (2020, October 13). 7 major challenges of a power grid and their solutions. Www.fuergy.com. https://www.fuergy.com/blog/7-problems-and-challenges-of-a-power-grid

digital twins and smart metres) to support an expanding, bi-directional, integrated digital energy ecosystem. This shortage hampers grid efficiency and limits the scope for data-driven innovations that could improve energy distribution and usage. Notable focus is being put on strategic investment into grid modernization and optimisation, emphasising capacity and connectivity upgrades, as well as digital twins and enhanced data usage to enable better resource management and grid stability[21]. It should also be noted that a key lever in this area is driving more informed energy use and enabling the increased roll out of RES within local ecosystems to allow them to operate independently and reduce strain on the central grid. See Action 5.

An example of this would be the deployment of electric vehicles (EVs) as small-scale power plants within energy communities (i.e. the strategic integration of photovoltaics / other RES and EVs within small energy communities which presents a transformative opportunity for both energy management and community resilience. EVs can here function as decentralised energy sources, providing flexibility to the grid as vehicle-to-grid (V2G) systems. Corporation EV fleets can be charged from PV panels on industrial roofs (supermarkets, logistic storage areas etc.), thereby reducing reliance on fossil fuels and contributing to reducing emissions and creating a more healthy atmosphere in cities.

This example highlights the importance of digital energy device integration and interoperability, with open APIs and standardisation protocols - this is another nascent area in Slovakia that limits functionality, flexibility, and device aggregation, undermining the potential for grid balancing and diminishing consumer confidence in digital energy systems. See Action 1 in the Joint Programme.

Connected to the lack of workforce capacity for driving the transition is the lack of knowledge of best available technologies (BAT) for the transition. Currently there is no single database or repository where this information is available, be it based on national or international research and case studies, thereby slowing down the adoption of proven technologies. Whilst the RePowerEU document highlights the importance of developing such a BAT database, this is not anticipated until 2026 and to be truly effective must draw on a dynamic, international knowledge pool. See Action 4 in the Joint Programme.

Limited access to experimental environments for digital energy technologies. Testing and developing innovative digital energy solutions is constrained by Slovakia's limited legal framework for experimentation. While digital energy sandboxes exist in other markets, their application in Slovakia has to date been ineffective, as these operate outside formal regulatory frameworks, making it difficult to trial solutions in real-world conditions. See Action 1.

It should also be noted that the slow uptake and development of clean energy solutions in Slovakia is prevalent across numerous additional areas ranging from wind energy, to carbon capture and storage

[21] Newsroom. (2024). Slovakia modernises power grid with EU support - CEENERGYNEWS. CEENERGYNEWS. https://ceenergynews.com/electricity/slovakia-modernises-power-grid-with-eu-support/

to hydrogen, all of which have significant opportunities to reduce the sector's impacts and integrate digital technology.

3.1.5 Ecosystem Connectivity

Effective collaboration is commonplace across Slovakia however is normally limited in its scope, i.e. academic collaboration is often with other academic partners (national and international) with an increasing inclusion of industry, whilst industry and public authority partnerships (i.e. regional authorities) are visible. Collaboration across the quadruple helix is very limited and creates challenges for truly transitional solutions that address not only the technological but also social elements of the transition. Visibility of ongoing collaborations, networks, and engagement platforms, as well as broader inclusivity, particularly of social considerations, in the transition's activities will facilitate a better connected, more holistic future state fit for the digital energy era. See Action 1 and 2.

3.1.6 Resilient Growth

With an increasingly digitised ecosystem, data and cybersecurity inevitably take on a greater role, and these two topics currently act as major blockers within Slovakia's digital energy transition, both creating significant political and social friction and concern, slowing the wider digitalisation progress. Although cybersecurity is a priority topic for Slovakia's overall development, there is minimal cross-over between cybersecurity and the energy sector, within minimal reference in Slovakia's National Cyber Security Strategy to energy, and vice versa in key strategic energy documentation. What information has been published by key national bodies at this energy x cybersecurity intersection is often outdated and sparse. See Action 6.

Inherently connected, is the role of data-gathering and sharing amongst energy stakeholders, and consumer protection concerns. This is another major challenge in Slovakia with limited visibility and exchange of energy data information by public bodies such as DSOs/ TSO which hinders coordination and efficiency across the sector, as well as limiting the innovation potential access to this data could offer. Although the Energy Data Centre in Bratislava has recently been launched and is expanding its functionalities, even this is limited in the nature of its purpose and data it will share, reducing the broader benefits that the ecosystem should be able to drive from such a data aggregator. See Action 7.

In summary, each of these challenges must be met with targeted interventions, integrated planning, and effective coordination across sectors. These recommendations form the basis for actionable steps that will be outlined in the following sections, aimed at advancing Slovakia's digital energy transition in a sustainable and resilient manner.

3.2 Slovakia: Actions

Note on actions included with Joint Programme vs National Action Plan

Several actions flagged as priority areas within the Slovak Ecosystem engagement and analysis have been excluded from the National Action Plan, and instead are outlined in the Joint Programme. These actions were deemed to be more suitable for international cooperation and to avoid duplication and fragmentation of efforts, these have only been outlined at the Joint Programme level however Slovakian stakeholders are still able to contribute to these.

List of Actions prioritised for Slovak Action Plan

1. Advocacy for Slovak policy and regulatory updates: Driving (1) digitalisation, (2) innovation and an (3) ambitious renewable, distributed energy system
2. Aligning higher education to the needs of the digital energy workforce
3. Digital Energy talent management: talent pathways, upskilling and dissemination
4. Digital Energy Transition awareness campaign
5. Strengthening grid stability through battery optimization
6. Integrating Cybersecurity into Energy Policy and Strategy: Development and Maturity Framework
7. Exploring energy data exchange for innovation and strategic insights

List of Actions prioritised for Joint Programme Plan

1. Designing for new energy systems: observability, standardisation and interoperability
2. Designing for new energy systems: Grid usage and management (capacity, aggregation, flexibility & ancillary Services)
3. Facilitating international knowledge exchange for energy sharing groups (communities and hubs)
4. Best Available Technologies (BAT) Open Repository: Curating resources for the digital energy transition.
5. Advancing digital energy innovation education: Tailored training for leadership and workforce development.
6. Strengthening communication and dissemination networks for the digital energy transition
7. Fostering energy innovation ecosystems for the digital energy transition

Link HERE to full Joint Programme action descriptions in the Joint Programme Plan

3.2.1 Advocacy for Slovak policy and regulatory updates: Driving (1) digitalisation, (2) innovation and an (3) ambitious renewable, distributed energy system

Action Title Advocacy for Slovak policy and regulatory updates: Driving (1) digitalisation, (2) innovation and an (3) ambitious renewable, distributed energy system	**Action Reference #:** S1 **Action status:** Not started

Action Objective

- Champion EU-aligned energy digitalization, and renewable energy diversification and expansion: Align key national climate, energy and digital strategies (and owners), particularly the NECP, to be more ambitious and focus on implementation / actionable updates
- Encourage more proactive approach to incorporating EU directives on clean energy (Renewable Energy Directive, "RED III") into national legislation
- Encourage Slovakia's engagement in international energy innovation via lower barriers to national funding programs and supporting implementation of validated energy technologies from across the EU

Action Description

- 4 core pillars of advocacy
    - Cross-cutting digitalisation, innovation and climate agenda
    - Updates to National strategies (NECP)
    - Updates to Legislation and regulation
    - Updates to National funding landscape

Phase 1: Establish working group processes and governance:
Action will be delivered by a strategic working group composed of key stakeholders across the quadruple helix—NGOs, research institutions and Academia, industry leaders and consumer associations, and public authorities. This group should bring together experts in advocacy and dissemination, strategy, policy and funding. The group will conduct research and analysis into required updates against key activity pillars (leveraging existing analysis and review documents supplemented by additional stakeholder engagement).

Phase 1 will be to formalise the working group, establishing governance protocols, decision-making processes, and timelines to ensure structured coordination. Roles and responsibilities will be clearly defined, and resources will be allocated to support the working group's activities.

Phase 2: Advocacy and dissemination strategy (incl. mapping)
The advocacy and dissemination strategy will be developed to guide core messaging, outreach and communication efforts. This includes mapping the existing landscape of stakeholders, identifying key influencers, and understanding their positions and priorities. The strategy will also outline tailored messaging, communication channels, and the timing for campaigns to maximise impact. A key focus will be on identifying existing best practice for advocacy within Slovakia and elsewhere. The project will use a multi-channel approach, designing both targeted public authority, policy makers, and industry leader advocacy campaigns as well as public consultation initiatives to increase awareness among the general public, to help exert bottom-up pressure.

Phase 3: Gap analysis & best practice mapping aligned to each pillar (existing materials)
A thorough gap analysis will be conducted to evaluate the alignment of Slovakia's current strategies, legislation, and funding programs with EU directives and best practices. Considerable work has already been done in this space for each of the focus areas and therefore the project focus will be on summarising and validating this work instead of replicating it. The project will build on desk analysis with workshops and discussion forums to identify additional best practice from national and international stakeholders. Based on the analysis, key recommendations will be identified for each pillar.

- Key focus areas within analysis for NECP and national strategies will incorporate:
    - Enhanced Renewable Energy System (RES) integration: Emphasise innovative pathways, such as waste-to-energy, smart grid digital tools, and advanced waste heat utilisation.
    - Ambitious deployment targets: Propose increased targets for greenhouse gas reduction and energy efficiency, aligned with EU objectives.
    - Digital tools for grid modernization: Advocate for the deployment of digital tools supporting smart grid operations and grid stability.
    - Social measures for energy accessibility: Recommend policies to protect and empower energy-poor regions and stakeholders.
    - Implementation-focused strategy: Suggest actionable measures, including investment plans, technological support, and regulatory improvements in areas like permitting and grid access.
- Regulation and Legislation updates will be closely aligned to NECP recommendations
    - Comprehensive audit of current national energy policies, with a particular focus on identifying discrepancies with RED III;
    - Framework modernization for market access: Prioritise updates to create a streamlined, accessible market structure for RES developers and investors, simplifying entry points and reducing administrative burdens;
    - Best practice for fostering a pro-innovation, flexible regulatory environment - reducing barriers and expanding support for experimentation, testing and scaling of clean energy innovations (i.e. sandboxes, living labs, low-regulation zones, fast-track approvals etc.). Analysis will draw on successful case studies and best practices from both domestic and international contexts.
    - Promoting more adaptable, dynamic (modular) policy to keep pace with sector advancements
- National Funding analysis will focus on

- Existing and additional support for increasing uptake of national funding (awareness of, and financial and technical support for applications)
- Increasing implementation and success in national funding (Reduction in bureaucratic barriers during and following application e.g. harmonising funding protocols with EU eligibility criteria, reduced administrative requirements for SMEs etc.)

Phase 4: Advocacy content development
Building on the findings from the gap analysis and recommendation, phase 4 will focus on curating core messaging content, i.e. position papers, statements, advocacy letters, policy recommendations, case studies etc. A diverse array of communication materials will be developed to support the advocacy efforts and engage a wide range of stakeholders effectively.

Phase 5: Stakeholder outreach: Advocacy and awareness campaigns
The final phase will execute the stakeholder outreach strategy through targeted advocacy and awareness campaigns. The action will partner with other events, host workshops, webinars, and roundtables to engage policymakers, industry leaders, and the general public. These campaigns will aim to build consensus on proposed updates, increase stakeholder buy-in, and promote the benefits of aligning national policies and practices with EU energy digitalization and renewable energy directives. Feedback collected during this phase will be used to refine recommendations and ensure effective implementation.

Action Owner & supporting stakeholders

- The coordinating entity is yet to be confirmed as part of ongoing validation of additional interested parties.
- Broad consortium will be required to incorporate experts across advocacy, communications, funding, regulation, and energy strategy.

Confirmed interest

- G-Institute
- Slovak Innovation and Energy Agency (SIEA)
- Slovak Battery Alliance
- Kosice Technical University (TUKE) Innovation Hub
- Slovak Alliance for Innovation Economy (SAPIE)

Next steps

- Full consortium mapping and identification of relevant funding opportunities.
- Develop detailed project plan
- Identification of common advocacy priorities amongst consortium partners

Deliverables / outcomes

- Advocacy and consultation strategy
- Stakeholder engagement plan & insights report

Timeframe

- Duration: 2yrs
- M1-3: Working group established and governance defined

<table>
<tr><td>List of recommendations for updates to NECP
Regulatory gap analysis report (incl. market access modernization & dynamic modular policy map)
Position papers, statements, and core messaging</td><td>M4-8: Initial analysis and validation of existing independent recommendations + advocacy strategy
M9-12 Initial development of advocacy materials and channels
M12-24 Ongoing advocacy campaigns and iteration of messaging</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?
No change required for advocacy actions themselves however this is of course the desired outcome.</td></tr>
<tr><td>Existing funding sources
No existing funding in place</td><td>Additional budget required
Full project financing required, to explore both public and private avenues (national and international level. e.g. World Bank funding for Self-Government Regions in Just Transition Fund)
Able to approach funding in ‘modular’ fashion if appropriate call identified for subaction.
Anticipated total cost: €400,000 - €600,000</td></tr>
<tr><td>Problems # mapping
Strategic misalignment, disconnect with EU ambitions & low knowledge of transition needs & benefits: 204-210, 212-214</td><td>Recommendations # mapping (why)
Policy & Regulation: 5.1.1.; 5.1.2
Market State & Funding: 5.2.1; 5.2.2</td></tr>
</table>

3.2.2 Aligning higher education to the needs of the digital energy workforce

<table>
<tr><td>Action Title
Aligning higher education to the needs of the digital energy workforce</td><td>Action Reference #: S2
Action status : Not started</td></tr>
<tr><td colspan="2">Action Objective:
To equip Slovakia's future workforce with essential digital and energy competencies by modernising the national curriculum and fostering stronger collaboration between higher education institutions (HEIs) and industry. This initiative will ensure consistent, high-quality skills development across education levels to support the digital-energy transition.

Action Description
• Phase 1: National curriculum review & Skills strategy update: Undertake a comprehensive review of the curriculum to identify gaps and opportunities for enhancement in digital energy skills, ensuring alignment with evolving sector demands. Update the national skills strategy to reflect emerging digital and renewable energy competencies, prioritising skills that will be essential in the future energy landscape.
• Phase 2: Industry partnerships for practical learning and technical placements: Establish partnerships between HEIs and industry associations to design and expand industry-focused modules, technical placements, and internships as well as identifying / expanding / building technological training centres. Emphasise hands-on experience in areas like digital grid management, smart energy systems, and renewable energy deployment, creating clear pathways for students into the digital energy sector.
• Phase 3: Accreditation and curriculum flexibility enhancements: Review and streamline accreditation processes and course development pathways to support curriculum flexibility and adaptability. Work with accreditation bodies, HEIs and other EU projects in this space (e.g. Net Zero Academies) will be undertaken to simplify pathways for new course approval, particularly those that address emerging digital-energy needs, reducing bureaucratic barriers to agile curriculum updates.
• Phase 4: Early integration and alignment with secondary education: Update educational alignment frameworks with secondary schools, including grammar schools, to introduce digital energy concepts early in students' academic journeys. Develop awareness programs and pre-university modules that highlight career pathways in the digital energy sector, ensuring a seamless educational pipeline from secondary to higher education and into the workforce.</td></tr>
<tr><td>Action Owner & supporting stakeholders
• Coordinating entity is yet to be identified
• Interested parties being validated across government ministries and agencies,</td><td>Next steps
• Full consortium mapping and identification of relevant funding opportunities.</td></tr>
</table>

<table>
<tr><td>Industry Associations, HEI associations & training providers etc..

Confirmed interest
G-Institute
Slovak Innovation and Energy Agency (SIEA)
Slovak Battery Alliance
Kosice Technical University (TUKE) Innovation Hub</td><td>Develop detailed project plan
Outreach to existing EU initiatives / associations developing material in this space to align on synergies / strategic partnership</td></tr>
<tr><td>Deliverable / outcomes
Updated national skills strategy
HEI curriculum standardisation frameworkMOI between industry partners and HEI;
Flexible accreditation strategy</td><td>Timeframe
Duration: 18 months</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No</td></tr>
<tr><td>Existing funding sources
No existing funding in place</td><td>Additional budget required
Full project financing required
Anticipated total cost: €350,000 - €500,000</td></tr>
<tr><td>Problem # mapping
Skill and expertise gaps in private sector: 258-260</td><td>Recommendations # mapping
Human capital: Education, Awareness, Workforce: 3.1, 3.2</td></tr>
</table>

3.2.3 Digital Energy talent management: talent pathways, upskilling and dissemination

Action Title Digital Energy talent management: talent pathways, upskilling and dissemination	**Action Reference #:** S3 **Action status :** Not started

Action Objective

- To equip Slovakia's energy and public sectors with advanced digital and energy skills via upskilling and knowledge sharing within the current workforce
- To establish Slovakia as a premier destination for talent in digital skills and renewable energy by creating structured pathways that attract, develop, and retain domestic and international experts, addressing immediate industry needs and fostering future growth.

Action Description

The Project will include two core pillars of activity:

- Upskilling existing talent (e.g. targeted sector skills workshops and emerging technology knowledge sharing; cross-sector partnerships and upskilling programmes, enhancing dissemination of existing knowledge-exchange channels
- Attracting and retaining new talent (e.g. career pathways and development programmes; incentives and showcases)

Upskilling existing talent:

- **Informal capacity building for leadership:** Develop capacity-building programs for government officials and industry leaders in digital and green energy. The delivery format will primarily be via knowledge exchange discussions (i.e. on Energy Directives) with technical diplomats and industry associations. Exchange programmes with countries that have mature digital energy systems, short-form thought leadership and alternative training designed for leadership profiles.
- **Launch a Series of Industry and Public-Sector Workshops & short-course upskilling programmes:** Introduce workshops focused on essential skills for the energy digitalization transition, covering topics like managing complex digital systems, securing data exchange, and deploying resilient, scalable digital infrastructure. These workshops will be tailored to both industry professionals and public authorities, ensuring practical knowledge transfer and policy readiness. Targeted skills programmes will be developed on priority transition areas, incorporating industry insights of market needs and applied use-cases. The action will aim to engage with parallel EU initiatives also driving the skills agenda (e.g.,The Large Scale partnership on skills for digitalisation of energy) to identify best practice, synergies and maximise reach.

- **Public Authority-Focused Initiatives: Targeted Briefings for Policymakers on Emerging Energy Technologies:** The action will host specialised briefings for policymakers and regulators, covering critical energy trends in Slovakia, such as hydrogen, battery technology, and energy communities. Focus discussions on the benefits, risks, and innovative business models associated with these technologies to support regulatory approaches that encourage their adoption and secure Slovakia's position in the energy transition.
- **Boosting Awareness and Engagement in Knowledge-Sharing Channels:** The action will promote existing knowledge-sharing channels across the energy sector, driving awareness and participation in workshops, programs, and upskilling opportunities from strategic organisations to foster wider engagement and accelerate cross-sector collaboration and knowledge-sharing. Consideration will be given to how best to disseminate and increase awareness around these channels.

Attracting and retaining new talent: Develop a comprehensive talent attraction and retention program tailored to the digital renewable energy sector, with competitive incentives, structured career paths, skill-building opportunities, and targeted recruitment strategies. This initiative will support Slovakia's positioning as a hub of renewable energy innovation, appealing to top talent both locally and globally.

- **Structured career pathways & Development programs:** Design clear, structured career pathways that outline progressive stages of professional growth, from entry-level roles to advanced positions. Incorporate mentorship programs, professional accreditation options, and specialised modular learning tracks in areas like digital grid management, renewable energy integration, and energy data analytics.
- **Financial incentives & Skill-building opportunities**: Conduct a comprehensive review of financial incentives, such as competitive salary packages, signing bonuses, relocation assistance, and performance-based rewards to attract high-calibre talent. Implement programs for continuous skill-building, including short courses, certifications, and access to cutting-edge digital tools, supported by opportunities for international secondments and project-based exchanges with global renewable energy leaders.
- **Targeted Attraction of Slovak and International Talent**: Develop targeted recruitment strategies to bring back Slovak talent from abroad and attract international experts. Create networking events, job fairs, and alumni networks in partnership with international universities and industry organisations to engage talent with ties to Slovakia. Highlight career opportunities in renewable energy for skilled Slovak professionals returning from international roles.
- **Showcase Slovak Innovation in Renewable Energy**: Promote Slovakia's leading projects and advancements in renewable energy and digitalization through industry events, digital marketing, and international conferences. Emphasise the country's innovative work in areas like smart grids, energy storage, and renewable integration to strengthen its reputation as a leader in the field, enhancing its appeal to top-tier professionals.
- **Talent Retention through Recognition and Community Building**: Develop retention programs that emphasise career satisfaction and a sense of community among renewable energy professionals. Host annual recognition events, innovation showcases, and networking opportunities to celebrate achievements and foster connections among industry peers, creating an environment that supports long-term commitment to Slovakia's renewable energy sector.

<table>
<tr>
<td>Action Owner & supporting stakeholders (who)
The coordinating entity is yet to be identified, interested parties being validated.
Confirmed interest
Slovak Innovation and Energy Agency (SIEA)
Slovak Battery Alliance
Slovak Alliance for Innovation Economy (SAPIE)</td>
<td>Next steps
Full consortium mapping and identification of relevant funding opportunities.
Develop detailed project plan</td>
</tr>
<tr>
<td>Deliverable / outcomes
Workshop curriculum and materials
Industry-academia upskilling program outline
Sector-wide communications campaign toolkit
Digital renewable energy career pathway guide
Financial incentives program
Modular learning & International secondment framework
Recruitment & Talent engagement plan</td>
<td>Timeframe
Duration: 2 years
M1-4 Framework, governance and stakeholder outreach for upskilling events (trainers, moderators, recipients etc.);
M1-6 Talent management strategy developed
M7-24 Ongoing content preparation and delivery
M7-24 Dissemination and integration of talent strategy with quadruple helix stakeholders</td>
</tr>
<tr>
<td colspan="2">Policy / Regulatory change required?: No</td>
</tr>
<tr>
<td>Existing funding sources
No existing funding in place</td>
<td>Additional budget required
Full project financing required
Anticipated total cost: €900,000-€1.1M</td>
</tr>
<tr>
<td>Problem # mapping
Mindset and knowledge gaps in public sector, Skill and expertise gaps in private sector: 255-257, 258-260</td>
<td>Recommendations # mapping
Human capital: Education, Awareness, Workforce: 3.3</td>
</tr>
</table>

3.2.4 Digital Energy Transition awareness campaign

Action Title Digital Energy Transition awareness campaign	**Action Reference #:** S4 **Action status :**Not started

Action Objective
To increase public and SME awareness, understanding, and support for Slovakia's digital energy transition by delivering targeted, inclusive campaigns that emphasise community involvement and address key challenges like renewable energy acceptance, NIMBYism, and nuclear dependency.

Action Description
Develop and implement a comprehensive awareness campaign to educate SMEs and the public about the opportunities, tools, and benefits of the digital energy transition. The campaign will focus on fostering broad support for renewable energy while addressing potential concerns and misconceptions.

Campaign Components:

- Public and SME-Focused Educational Campaigns: Launch campaigns that highlight the economic, environmental, and societal benefits of digital energy advancements, using tailored messaging to appeal to both SMEs and the general public. Provide clear guidance on how businesses and individuals can leverage these tools to reduce costs, increase efficiency, and contribute to climate goals.
- Citizen and Community Engagement Initiatives: Prioritise citizen and community involvement to address common concerns about renewable energy, specifically aiming to counter the "Not In My Backyard" (NIMBY) mentality and reduce reliance on nuclear energy. Incorporate opportunities for community feedback and collaboration, allowing local voices to contribute to and feel ownership of energy projects.
- Diverse Educational Channels and Activities:
    - Regional Workshops: Interactive, in-person workshops across various regions to engage local communities, provide hands-on learning, and answer questions about the digital energy transition.
    - Digital Energy Literacy Programs: Online resources and courses to increase understanding of digital energy concepts, especially targeting SMEs, young professionals, and other stakeholders.
    - Secondary School Curriculum Integration: Collaborate with educational bodies to integrate digital energy topics into secondary school curricula, fostering early awareness and interest in the energy sector (i.e. Propagation of topic through presentation of experts on ongoing latest research, educational and policy projects at Secondary Grammar School sites.).
- Focus on Community-Based Renewable Energy and Digital Advancements: Centre the campaign around community-based renewable energy technologies, such as local solar or

<table>
<tr><td colspan="2">wind projects, to showcase tangible examples of renewable solutions that benefit communities directly. Clarify how digital tools like smart metres, grid management systems, and IoT devices enhance renewable energy integration, reinforcing the combined impact of digital and renewable advancements.
• Addressing Misinformation and Highlighting Benefits: Counter misinformation and promote clear, accurate information on renewable energy and digital technologies. Emphasise the personal, economic, societal, and climate benefits of the energy transition, using real-life case studies and testimonials to build trust and drive engagement.</td></tr>
<tr><td>Action Owner & supporting stakeholders (who)
• The coordinating entity is yet to be identified, interested parties being validated.

Confirmed interest
• Slovak Innovation and Energy Agency (SIEA)
• Kosice Technical University (TUKE) Innovation Hub
• Slovak Alliance for Innovation Economy (SAPIE)</td><td>Next steps
• Full consortium mapping and identification of relevant funding opportunities.
• Develop detailed project plan</td></tr>
<tr><td>Deliverables / outcomes
• Stakeholder engagement strategy and roadmap;
• Set of educational tools and programmes;
• Public and SME-Focused Educational Campaign Materials</td><td>Timeframe
• Duration: 18 months
• M1-3: Stakeholder engagement strategy & mapping + initial expert outreach + digital platform;
• M3-6 Campaign materials development;
• M7-12 Pilot campaigns (round 1);
• M7-18 Feedback and iteration of campaign materials
• M13-18 Evaluation and expansion of campaigns;</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No</td></tr>
<tr><td>Existing funding sources
• No existing funding in place</td><td>Additional budget required
• Full project financing required
• Anticipated total cost: €300,000 - €500,000</td></tr>
<tr><td>Problem # mapping
Low public interest in green transition topics and opportunities, Low consumer engagement, Conflicting public communication: 242-247, 248-250, 251-254</td><td>Recommendations # mapping
Human capital: Education, Awareness, Workforce: 3.4, 3.5, 3.6</td></tr>
</table>

3.2.5 Strengthening grid stability through battery optimization

Action Title: Strengthening grid stability through battery optimization	**Action #:** S5
	Action status: Not started

Action Objective

- Conduct industry-led collaborative R&I to create solutions that can improve grid management
- Combine technical know-how, market and business model expertise, and extensive network and dissemination potential to generate market-ready outputs to increase speed to impact

Action Description

This action will be focused on 3 key workstreams:

- Economic Viability of Frequency Regulation by Activating Energy Reserve from Batteries
- Development of Next-Generation Controller for Automated Dispatch of Ancillary Services Using Li-Ion Batteries
- Dissemination and commercialisation of outputs

Economic Viability of Frequency Regulation by Activating Energy Reserve from Batteries

The objective of this activity is to develop a comprehensive understanding of the economic feasibility of utilising battery energy reserves for frequency regulation, a critical aspect of efficient battery control and grid management. The research will focus on generating a robust dataset on grid stability to train machine learning models. This dataset will integrate relevant data from transmission system operators (TSOs), market conditions, and weather patterns. Additionally, the activity will deliver a suite of analytical tools to facilitate data-driven insights, enabling advanced predictions and optimizations for network stability.

- **Phase 1:** Identification of critical factors influencing the economic viability of battery-based frequency regulation, including the conditions required for successful implementation.
- **Phase 2:** Analysis of the predictability of these factors to inform decision-making and enhance operational efficiency.
- **Phase 3:** Investigation of the variables impacting frequency stability to improve system reliability and ensure effective integration of battery reserves.

Development of Next-Generation Controller for Automated Dispatch of Ancillary Services Using Li-Ion Batteries

This activity aims to design and prototype an advanced automated dispatch control system tailored for ancillary services provided by Li-ion batteries. The initiative will include a comprehensive feasibility

<table>
<tr><td colspan="2">study to evaluate the applicability of legal and technical requirements for Transmission System Operators (TSOs) in the target region(s). By harmonising operational strategies and addressing regulatory constraints, this activity seeks to enhance the efficiency and reliability of battery-based ancillary services.

● Phase 1: Conduct an in-depth investigation of the legal and technical requirements for TSOs in the target region(s), ensuring compliance and integration into existing frameworks.
● Phase 2: Explore and develop optimal coordination strategies for Li-ion battery systems, focusing on:
○ Maximizing energy storage capacity.
○ Extending battery lifespan.
○ Enhancing operational safety.

Dissemination & commercialisation of outputs
This activity will focus on dissemination of R&I findings into the academic & industrial community as well as the development of a clear market-integration strategy for the Dispatch Control System solution.</td></tr>
<tr><td>Action Owner & supporting stakeholders (who)
Owner: PowereX</td><td>Next steps
● Full consortium mapping and identification of relevant funding opportunities.
● Develop detailed project plan</td></tr>
<tr><td>Deliverables / outcomes / measures (what)
● Feasibility study on applicability of legal and technical requirements for TSO ’s in target region(s)
● Prototype of automated dispatch control system
● Academic publications
● Go-to-market strategy</td><td>Timeframe (when)
● Duration: 2 years
● M1-9 Economic viability assessment;
● M10-22 Development of dispatch control system prototype;
● M23-24 Dissemination and commercialisation of outputs</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: Not directly, however dissemination activities will incorporate policy maker engagement and upskilling on grid capacity & management topic to target regulatory / legislative change that facilitates integration of storage & RES technologies into grid</td></tr>
<tr><td>Existing funding sources
● No existing funding in place</td><td>Additional budget required
● Full project financing required c.€350k required</td></tr>
<tr><td>Problem # mapping
Insufficient grid stability and connectivity: 267, 271, 279, 282</td><td>Recommendations # mapping
N/A action identified after original recommendation mapping</td></tr>
</table>

3.2.6 Integrating Cybersecurity into Energy Policy and Strategy: Development and Maturity Framework

Action Title Integrating Cybersecurity into Energy Policy and Strategy: Development and Readiness Framework	**Action Reference #:** S6 **Action status :** Not started

Action Objective

To enhance cybersecurity resilience across the energy sector by:

- Updating energy strategies for greater prominence of cybersecurity requirements and vice versa
- Creating a tailored maturity model and aligned cyber hygiene protocols that address the specific cybersecurity needs of each energy sector stakeholder group.

Action Description

Energy x Cybersecurity strategy review and updates

- **Conduct a Comprehensive Cybersecurity Assessment:** Perform a thorough review of Slovakia's existing cybersecurity strategy as it pertains to the digital energy sector. This assessment will identify current strengths, weaknesses, and critical gaps in protecting digital energy infrastructure. Evaluate how well existing policies and practices address both internal and external cybersecurity threats and the ability to respond to evolving risks.
- **Benchmark Against EU Protocols and Emerging Threats**: Benchmark the strategy against EU standards, including the latest requirements in the NIS2 Directive, to ensure compliance and alignment with best practices. Identify any misalignments or deficiencies in the current strategy that may affect Slovakia's ability to meet EU cybersecurity objectives and protect against advanced threats targeting the energy sector.
- **Update Strategy to Reflect Enhanced Cybersecurity Protocols**: Revise the cybersecurity strategy to incorporate strengthened EU protocols, focusing on resilience in key areas such as incident response, threat intelligence sharing, and critical infrastructure protection. Emphasise actionable steps that align Slovakia's digital energy security practices with NIS2 requirements, bolstering protections across distribution systems, grid operations, and energy providers.
- **Develop a Roadmap for Implementation and Stakeholder Engagement**: Create a clear roadmap for implementing the updated cybersecurity strategy, including timelines, key actions, and resources needed to ensure effective adoption across the energy sector. Engage stakeholders through workshops and advisory sessions to promote a shared understanding of new responsibilities and protocols.

Cyber Security Maturity model

<table>
<tr><td colspan="2">

- **Develop a Role-Specific Cybersecurity Maturity Mode**l: Design a comprehensive cybersecurity maturity model tailored to the diverse roles within the energy sector, including Distribution System Operators (DSOs), energy providers, and consumers. This model will define cybersecurity requirements and responsibilities at each maturity level, ensuring that the distinct security functions and needs of each group are addressed.
- **Establish Cyber Hygiene Protocols and Guidelines by Maturity Level**: Develop a corresponding set of cyber hygiene protocols, guidelines, and best practices aligned with the maturity levels in the model. These protocols will provide step-by-step recommendations for security practices that are appropriate for each stage of cybersecurity maturity and role type, from foundational measures for consumers to advance requirements for DSOs and providers.
- **Integrate Sector-Specific Threat Scenarios and Response Frameworks**: Include sector-specific threat scenarios within the maturity model to ensure stakeholders are prepared for common risks unique to energy infrastructure, such as threats to grid operations, data breaches, and system vulnerabilities. Define response frameworks and contingency plans that are scaled to each maturity level and stakeholder role.
- **Facilitate Stakeholder Training and Support**: Provide training resources and workshops based on the model to help stakeholders understand and implement the recommended cyber hygiene practices. Offer tailored support to help DSOs, providers, and consumers move up the maturity levels and adapt to evolving cybersecurity threats.

</td></tr>
<tr><td>

Action Owner & supporting stakeholders

- The coordinating entity is yet to be identified, interested parties being validated.

</td><td>

Next steps

- Full consortium mapping and identification of relevant funding opportunities.
- Develop detailed project plan

</td></tr>
<tr><td>

Deliverable

- Cybersecurity assessment report
- Updated National cybersecurity strategy document

</td><td>

Timeframe

- M1-6 Review and dissemination of energy x cybersecurity strategy and proposed updates;
- M7-18 Development of cyber security maturity model;
- M19-24 Dissemination and upskilling on cyber security maturity models

</td></tr>
<tr><td colspan="2">

Policy / Regulatory change required?: No change required for the action itself but targeting stricter and more consistent approach to cybersecurity within the energy sector to be mandated as a result of project insights.

</td></tr>
<tr><td>

Existing funding sources

- No existing funding in place

</td><td>

Additional budget required

- Full project financing required
- Anticipated total cost: €200,000 - €400,000

</td></tr>
<tr><td>

Problem # mapping

Insufficient cybersecurity measures in digital energy:

</td><td>

Recommendations # mapping

Resilient Growth: Enhance narrative and

</td></tr>
</table>

300-302	understanding of cyber security challenges within the digitalisation of the energy sector

3.2.7 Exploring energy data exchange for innovation and strategic insights

Action Title Exploring energy data exchange for innovation and strategic insights	**Action Reference #:** S7 **Action status :** Not started
Action Objective To create a robust framework for energy data collection, sharing, and governance that enables effective collaboration, trust, and optimised grid management across the energy sector. **Action Description** Establish a structured framework for collecting, exchanging, and sharing energy data among relevant stakeholders, including energy providers, consumers, regulators, and policymakers. Define the specific roles of each stakeholder to ensure transparent and effective data use. Given the sensitivity of energy data exchange (strategic value and competitive advantage etc.) need clear requirements and benefits mapping for all stakeholders in the energy sector value chain, particularly TSOs / DSOs / industrial companies / energy providers / energy communities etc. Develop clear data governance policies outlining how data will be accessed, stored, and used. Establish consent mechanisms that inform users of data usage practices, building trust and encouraging participation in energy sharing initiatives. Promote the expansion of existing data gathering and aggregation facilities (e.g. the Energy Data Centre) considering best practice from partner countries (e.g. FEAK in Hungary) for effective grid management, demand response, and load balancing, and expand functionality and data availability for broader stakeholder groups. Design and implement small-scale pilot initiatives to test data-sharing mechanisms, governance protocols, and stakeholder engagement strategies.	
Action Owner & supporting stakeholders • Coordinating entity and key stakeholders yet to be engaged	**Next steps** • Full consortium mapping and identification of relevant funding

<table>
<tr><td></td><td>opportunities.
• Develop detailed project plan</td></tr>
<tr><td>Deliverable
• Energy Data Collection and Sharing Framework;
• Data Governance Policies;
• Pilot project validation reports</td><td>Timeframe
• Duration: 2 years
• M1-3 planning and design;
• M4-12 Energy sharing framework development;
• M13-18 Pilot implementation;
• M19-24 Pilot evaluation and scaling design</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No change required for the action itself but targeting a more transparent and consistent approach to data exchange within the energy sector to be mandated as a result of project insights.</td></tr>
<tr><td>Existing funding sources
• No existing funding in place</td><td>Additional budget required
• Full project financing required
• Anticipated total cost: €400,000 - €600,000</td></tr>
<tr><td>Problem # mapping
Underexplored data utilisation and privacy, Insufficient data collection and sharing: 303-304, 305-312</td><td>Recommendations # mapping
Resilient Growth: 6.1, 6.2, 6.3</td></tr>
</table>

4. The Netherlands

4.1 The Netherlands Ecosystem Analysis: Key Problems & Recommendations

The energy transition in the Netherlands is going into a new phase thoroughly changing the energy landscape. The Netherlands is diving into new waters as the existing energy system is failing to deliver cheap and easy access to electricity, gas and heat. Rapidly huge problems are arising such as thousands of businesses on a waiting list to get access to the grid. This hinders growth, sustainability goals and electrification of transport. In addition new houses are not being built and renewable production is being stalled. Although the grid operators are building new grids, the waiting period is around 6-10 years, with little options for faster building. At the same time the cost of this grid enhancements will easily double normal energy bills for households. In the meantime, renewable production is automatically turned off due to an excess of electricity during peak solar hours leading to dissatisfied customers and the amount of black outs are growing due to localised excess production or demand.

To solve these problems, more and more stakeholders have turned to smart digital solutions to make better use of the grid and use more energy efficiently in the location where it is produced. This kind of transformation to a more decentralized grid, demands changes in regulation, market roles, finance and technology with a big role for digitalisation as the game changing technology. With little to no real vision on what is exactly going to be the outcome, this transition is complex. All sorts of uncertainties arise and needed steps get delayed because of beliefs about decentralised versus centralised benefits. Although there is certainly also a call for more technological innovations, the primary challenge lies in organisational and societal steps for end-users, regulators, industries, energy companies, and grid operators. Building a smarter, more interactive energy system demands significant digitalisation, reorganization and conditions we are not even aware of yet, like operability and cybersecurity. This new system will bring us many benefits which will include increasing energy efficiency, decarbonization and predictable prices. However, there is a need for considerable improvements across areas as summarized below.

4.1.1 Policy & Regulation

Better communication on the importance of digitalisation

Digitalisation is not prioritised in policy-making guiding the energy transition. It requires more effective communication strategies on why digitisation is crucial. While some stakeholders recognize its

importance, many decision-makers find it difficult to connect digitalization with the current pressing societal challenge

Working on the energy system of the future: Aligning national policies with the Digitalising the Energy System - EU Action Plan could help to make better policies in which an integrated energy system and improved energy equity have an important focus, as well as potential risks of digitalization.

More agile and modular policies and regulation

Other challenges include outdated regulations and the absence of systematic, long-term planning. The current approach is too rigid to keep pace with a rapidly changing energy landscape. There is a need for agile policy making and development of modular laws based on close collaboration with cross-sectoral groups across quadruple helix. The creation of experimental regulatory zones will allow for the testing of systemic changes. A positive point is that efforts are taken to create a Dutch unified national agenda for the digitalisation of the energy sector.

4.1.2 Market and Funding

Modernisation of the market structures

The energy system innovations are driven by an outdated system, with rules often favoring economic outcomes for incumbent system players. Thus, current market rules hinder necessary innovation. Uncertainty, conservatism, and perceived high risk of new digital technologies slow down new innovative players in accessing the market and implementing their solutions. There is a need for incentives for smaller players through grants and subsidies, which focus on promoting integration across the energy system.

Redefining tariffs for a hybrid energy market

The current tariff structures are designed for a centralized market, but there is no clear vision for a tariff system that can effectively support a hybrid energy market—one that is both centralized and decentralized. Simulation tools and digital twins offer valuable insights into congestion management and energy efficiency. By testing new roles and tariff structures, these tools enable the energy sector to proactively work towards sustainable growth, rather than merely reacting to crises.

4.1.3 Human Capital

Closing the energy sector's digital skills gap

The transformation offered by digitalisation is not well understood by businesses and the general public. The current workforce in the energy sector often has limited skills and knowledge in digitalisation, decentralisation, and emerging technologies. There is a significant shortage of skilled professionals in the energy sector, with an estimated gap of 18,000 professionals. There is a need for continuous

professional development to keep pace with the rapidly evolving energy landscape. Also, the level of digital literacy of decision makers should be increased to raise awareness of the impacts, the opportunities, and the threats of digitalisation for the energy system.

Furthermore, linking digitalisation to societal benefits, such as cost savings, faster solutions to grid congestion, and improved urban planning, will ensure that policymakers and the public see its relevance.

4.1.4 Technology Adoption & Deployment

Modernizing energy regulations for digital transformation

Energy regulations need updates to enable digital transformation, addressing issues like non-standardized communication protocols and security gaps. Energy projects often overlook end-user needs, limiting their adoption, effectiveness, and acceptance.

Development of consumer-oriented tools

Consumer-oriented digital tools are needed, especially to support people who are less familiar with the digital transition. For instance, the complexity of residential energy systems is growing, and transparency is lacking, making it difficult for consumers to understand their systems or trust the contractors involved. Often the end-users' needs are not considered in energy technology projects. Including them, will build trust and facilitate widespread adoption.

Open standardization and interoperability measures

In addition, to avoid vendor lock-in, open standards and interoperability must be prioritized. There are design principles from the Club van Wageningen, which should be considered more often to guarantee compatibility across systems and long-term value.

4.1.5 Ecosystem Connectivity

Strengthening collaboration for inclusive energy innovation

Collaboration among the Dutch quadruple helix entities is limited by a lack of incentives and dedicated platforms. This lack of synergy affects the effective deployment of energy transition solutions. More specifically, there is insufficient cross-sector collaboration, which restricts innovation and slows down progress. Citizens, particularly underrepresented groups, need more involvement in energy regulation and policy development. While these groups participate in various pilot projects, the valuable lessons and best practices often fail to inform new initiatives or reach policymakers. Additionally, greater collaboration with other sectors such as telecom could further improve solutions. To address these challenges, fostering stronger partnerships across sectors and involving citizens more actively in decision-making processes is essential. By creating more collaborative opportunities and ensuring that

lessons from pilots are effectively shared, innovation in the energy sector can be accelerated and will be more inclusive.

Facilitating energy hubs through collaboration and knowledge sharing
A positive point is the current simulation programme for energy hubs in which KGG supports a broad cooperation and knowledge sharing between end users and all sorts of stakeholders to stimulate energy hubs. This programme took off in response to the above and is a huge facilitator of more inclusive discussions and policy making.

4.1.6 Resilient Growth

Energy planning
Policymakers are using spatial planning to add a new layer which is energy planning. As the Dutch face the serious challenge of grid congestion, a need arises for simulations and experimental areas to better understand the future and impact of proposed solutions. Modelling possible energy scenarios can help governments, DSOs, and end-users identify optimal solutions and introduce a new policy instrument, best described as energy planning.

Securing data sharing for a digital energy future
Data sharing in the energy sector is a delicate topic that entails concerns over privacy, competitive advantage, and the risk of cyberattacks, with digitalisation introducing new vulnerabilities. To address these issues, a federative data system should be adopted, where data remains decentralised at multiple locations but can be accessed and used in a unified way, ensuring privacy and security. Effective data sharing requires robust cybersecurity measures, clear regulations, and adequate funding. Additionally, device interoperability is essential for scaling and deployment.

4.2 The Netherlands: Actions

Hereafter is the list of the Actions collected for the Dutch Action Plan. These actions cover all levels of governance,from national, regional, to industrial sites levels, and tackle many of the issues and recommendations developed in the WEnnovate project, such as user-friendly tools to accelerate the adoption of the digitalisation of the energy system, easily accessible knowledge about those questions, or interoperability of the technology available or under development.

List of Actions prioritised for Dutch Action Plan

1. EmPower
2. Baas in Eigen huiS (BIES)
3. Energy Transition Institute

4. Path to Zero 2.0 - the way to collective energy autonomy
5. Bridging Gaps
6. Esilience serious game
7. Benefit for Balance
8. Open Heat NL
9. KIck off FLexibility INteroperability (KIFLIN)
10. Synergy energy innovation program
11. Facilitating Collaboration and Data Sharing

List of Actions prioritised for Joint Programme Plan

1. Designing for new energy systems: observability, standardisation and interoperability
2. Designing for new energy systems: Grid usage and management (capacity, aggregation, flexibility & ancillary Services)
3. Facilitating international knowledge exchange for energy sharing groups (communities and hubs)
4. Best Available Technologies (BAT) Open Repository: Curating resources for the digital energy transition.
5. Advancing digital energy innovation education: Tailored training for leadership and workforce development.
6. Strengthening communication and dissemination networks for the digital energy transition
7. Fostering energy innovation ecosystems for the digital energy transition

Link HERE to full Joint Programme action descriptions in the Joint Programme Plan

4.2.1 EmPower

<table>
<tr><td>Action Title:
EmPower / InCharge</td><td>Action #: NL1</td></tr>
<tr><td>Action Owner: Stedin</td><td>Action status: Between ideation and planning</td></tr>
<tr><td colspan="2">Action Objective / Description
Decentralised energy generation and storage are currently under-empowered compared to their centralised counterparts, limiting their growth potential. This shortfall stems from two primary issues: the existing financial energy system cannot naturally evolve to meet the needs of this new landscape, and there is still no full connectivity (Internet of Energy) to ensure that signals, including financial incentives, reach all necessary stakeholders.

With EmPower, we support, on one hand, the financial energy system's evolution by helping to create a level playing field for decentralised generation and storage to ensure open and equitable access to all exchanges and platforms, like GOPACS (Dutch platform where grid operators and market participants collaborate to ease grid congestion through flexible energy use) and the imbalance market, while directly addressing the challenges of congestion and imbalance in this evolution. On the other hand, we support the birth of the Internet of Energy by helping to establish the right rules of the game, supporting the development and adoption of open standards, protocols, and labels, and ensuring the empowerment of everyone not yet "smart" (like EMS) connected, through apps and offline solutions.

Through all these efforts, we can help create maximum competition between central and decentralised generation, storage, and consumption. This will result in the lowest possible energy prices while simultaneously solving congestion and imbalance, allowing energy to flow freely.</td></tr>
<tr><td>Supporting stakeholders
We have conducted an analysis at Stedin to identify the needs of grid operators. This analysis will be reviewed by other grid operators and key market players, including energy suppliers, energy cooperatives (EnergieSamen, Local4Local, etc.), the government, ACM, and many others.</td><td>Next steps
We are actively assessing stakeholder needs to identify low-effort, high-impact changes, starting with quick fixes to support the flexibility market and improve the trade in demand response, energy storage, and distributed generation to enhance grid efficiency and manage congestion.

In parallel, we are launching targeted pilots, studies, and simulations to rigorously test and refine grid tariffs, energy taxation, and direct market access for all energy</td></tr>
</table>

<table>
<tr><td></td><td>producers, consumers, and storage users. These steps lay a strong foundation for a smarter, more adaptable energy system.</td></tr>
<tr><td>Deliverables / outcomes / measures
Extreme prices in GOPACS and imbalance markets are being tackled by making network tariffs and energy taxes dynamic, incorporating imbalance, congestion, and sustainability.

Empowering everyone who generates, consumes, or stores energy is achieved by establishing fair rules for the Internet of Energy, supporting open standards, protocols, and labels, and enabling those without smart connections through apps and offline solutions. Direct access to exchanges, GOPACS, and the imbalance market will be made available to all. This progress will be driven through pilots (both in The Netherlands and in the other WEnnovate countries), data-backed evidence, discussions with key players, and support for initiatives beyond Stedin.</td><td>Timeframe
Q4: identify wishes of all stakeholders
Q1 2025: implement quick fixes
Q1-Q4 2025: various pilots, studies and simulations
Q2-Q4 2025: first adjustment of network tariffs</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: Yes. Adjusting grid tariffs and associated codes requires help from the ACM and the government. Adjusting energy taxation will require even more stakeholders. Providing direct access to all markets for anyone generating, consuming, or storing energy will require additional involvement..</td></tr>
<tr><td>Existing funding sources
For now, Stedi) will carry the entire cost of this action themselves. Perhaps one or more subsidies will be applied for later.</td><td>Additional budget required
Stedin needs additional funding to support essential, long-term pilot projects (here and in other WEnnovate countries) that account for seasonal variations and behavioral shifts. Multiple pilots are necessary to gather robust data for convincing the government and stakeholders of their impact. Additionally, funding will aid in developing and promoting open standards, protocols, and labels crucial for building the Internet of Energy and thus EmPowering everyone.</td></tr>
<tr><td>Problem # mapping
Policy and Regulations: 116
Market state and funding: 130, 134, 136, 137
Technology adaptation and deployment: 164
Ecosystem connectivity: 179, 181</td><td>Recommendations # mapping
Market state and funding: 2.1, 2.6
Technology adaptation and deployment: 4.3
Resilient growth: 6.2</td></tr>
</table>

4.2.2 Energy Transition Institute

Action Title: Energy Transition Institute	**Action #:** NL2
Action Owner: Sustainable Scale-up Foundation and Zenmo	**Action status:** Ideation

Action Objective / Description

The Importance of Decentralized, Community-Led Solutions
The Netherlands has gained global recognition for its leadership in the energy transition, excelling in areas like electric vehicles, offshore wind, and rooftop solar through centralized, policy-driven efforts. However, achieving a truly sustainable energy future also requires the development of decentralized, community-led initiatives. These initiatives, often overlooked by traditional system players in importance, are essential to tackling key challenges such as grid congestion, attracting new businesses, developing heat networks, securing permits, optimizing land use, and deploying batteries and flexibility effectively.

Leveraging Simulation Modeling and Digital Twins
To support policymakers, local initiatives and end users to develop successful decentralized local energy systems, simulation modeling is essential. **Digital twin models** are a powerful tool in this process, as they create a virtual replica of each local energy system. By simulating the unique conditions of each system—such as energy needs, resources, and local factors—these models help us understand how energy is exchanged within a hub between participants, and subsequently how each system interacts with the broader energy network. This provides valuable insights into how to optimize energy use, improve system design, and make better decisions for the local energy hubs as part of the overall energy transition. By modelling innovations and growth paths in a local energy system policy makers and end users get an idea of the challenges ahead. Such an approach would significantly enhance the effectiveness and scalability of decentralized energy solutions.

Improving Local Energy Systems through Independent Analysis of performed modelling
Recognizing this need, many organizations have created a variety of models tailored to specific contexts, providing knowledge, insights and investment decisions. However, this abundance of models can be overwhelming, and unidentified gaps in knowledge persist. An independent organisation is needed to collect and compare these models, identifying the questions they work with and the insights they provide. This will ensure the right use of models. If deemed necessary, the institute can also urge developers for better models or instigate models to build on knowledge or overlooked innovations.

The Energy Transition Institute
The Energy Transition Institute will consolidate knowledge and minimize duplication of efforts, enabling faster and more cost-effective solutions for energy projects. By gathering and analyzing outcomes of digital simulations into a single platform and analysing these simulation models on a national scale, we will uncover common denominators and knowledge gaps across various energy

systems. Disclosing these models to review innovative energy solutions and cases, will help policymakers and other stakeholders make better decisions on energy policy, investments, and grid expansion by identifying common patterns across different energy systems

Independence is essential for the success of the Transition Institute. The energy transition is increasingly held back by systemic inertia delaying more sustainable, cost-effective and resilient solutions. To address this, the Institute must take a disruptive approach, led by those committed to advancing bottom-up energy systems. This leadership will ensure the Institute can challenge the status quo and drive faster, more impactful progress in the energy transition. This disruption is vital for overcoming the regulatory and business-as-usual barriers currently hindering the energy transition's speed.

Goals
The outcome will be fourfold for these stakeholders:

1. Energyhubs/Companies: Sharing and analysing insights from already performed digital twins and simulations will help stakeholders understand certain aspects of their local energy system, such as growing congestion, but also the impact of smart solutions in their local hub. Seeing what insights have been given to these companies for concrete steps to deal with congestion, can lead to a growing demand in simulations. This will in turn lead to more cooperation in hubs and more sharing of data and investment plans. Better data will lead to the improvement of outcomes of digital twins. Companies that might not be interested to join normally can be pursued by the insights coming from already performed digital twins in other hubs.
2. Governments: Bringing outcomes of digital twin modelling together and sharing benefits seen with certain solutions can lead to better motivation in policy discussions and lead to acceleration of better contracts, regulatory changes and access to data.
3. Knowledge Institutions - providers: Having a database will help them with research into actionable policy recommendations. These will be disseminated to the right stakeholders and underline the importance of modelling. There will be better understanding of knowledge gaps in modelling.
4. The Netherlands: The country will see an accelerated shift to sustainable energy, with more efficient grid investments (estimated at over €10 billion annually) and a significant reduction in economic losses from grid congestion (currently estimated at €10–40 billion per year).

Strategy
The institute will aim to partner with existing solution providers (e.g., Zenmo, TU Delft), heat (e.g., Gradient), local energy markets (e.g., Groendus, Entrnce, Distro Energy), and multi-energy systems (e.g., TNO). Some tools are designed for planning and analysis, while others are used for daily operations. In some cases, tools can do both. The Energy Transition Institute will create a shared, independent space for learning and collaboration, and bring these tools together.

If scaled further, the institute could deliver nationwide simulations. For instance, by standardising processes and utilizing shared data from grid operators and companies, it would be possible to

<table>
<tr><td colspan="2">simulate optimal solutions for all business parks and neighbourhoods (e.g., optimising batteries, flexibility, charging infrastructure, PV systems, and heat networks). This approach would cost a fraction of conducting separate simulations for each area, providing local stakeholders with interactive models to prioritize effective measures.</td></tr>
<tr><td>Action Owner & supporting stakeholders
Sustainable Scale-up Foundation and Zenmo

Already started explorative discussions with parties from the modelling ecosystem</td><td>Next steps
Bringing together models, studies, partners and financing, and generating white papers that qualify and quantify the advantages of bottom-up transition pathways.

Firstly, the consortium will check whether there are existing projects that are similar. Then the following actors will be contacted: knowledge institute flex, provinces (IPO), VNG, top sector, Geonovum, universities (TU Delft, TU Eindhoven, DRIFT).</td></tr>
<tr><td>Deliverables / outcomes / measures
Model repository
Analyses
Guidance for municipalities and end-users on use of digital twins
Studies
Knowledge base</td><td>Timeframe
Current preparation, establishment Q2/Q3 2025</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No. The project will assess whether there are regulatory gaps or perception challenges that may require changes in the future, particularly as more data becomes available in the coming months.</td></tr>
<tr><td>Existing funding sources
Currently none

Thinkable:
Natura contribution models
Contribution knowledge Holon project
Contributions participants
Subsidies</td><td>Additional budget required
Initial budget: Secure EUR 200k to launch the initiative, establish partnerships, develop models, and obtain subsidies for analyses and studies, with a potential increase to EUR 300k if required.
Long-term funding: Arrange sustainable funding for a 10-year period.
Budget flexibility: Final budget allocation will depend on the comprehensive project plan.</td></tr>
</table>

Problem # mapping	**Recommendations # mapping**
Policy and Regulations: 103, 106, 108 Ecosystem connectivity: 174, 177, 178, 181, 186	Policy and Regulations: 1.6, 1.10 Ecosystem connectivity: 5.1, 5.2, Resilient growth: 6.5, 6.6

4.2.3 Bridging Gaps

Action Title: Bridging Gaps: Shaping Political and Administrative Awareness on the Role and Challenges of Digitalization with a Focus on Practical impact	**Action #:**NL3
Action Owner: Sustainable Scale-up Foundation	**Action status:** Not started, looking for funding

Action Objective / Description

Why

Currently, digitalisation of the energy system is not recognised as an important issue and therefore lacks political urgency. Politicians and administrators often fail to connect the need for digitalisation of the energy system with other urgent societal challenges. At the same time, they do not recognise possible negative outcomes of digitalisation as a societal problem. Many societal problems - grid congestion in business parks, energy inclusivity, and energy reliance - are deeply intertwined with the new opportunities and threats that stem from digital innovations. Many common aspects of the energy system (e.g., the building of new houses) have a strong digital component that is often overlooked.

If utilised effectively, the digitalisation of the energy system could unlock significant opportunities for Dutch society. For instance, the insights obtained from proper modelling with digital twins in energy hubs could help solve multiple societal issues. Yet, digitalisation remains siloed from other societal challenges, with departments tackling related issues—such as poverty, building, and energy—in isolation. A shared understanding of digitalisation and its broader impact is essential to cross this bridge.

How

The objective of the action is to create political and administrative awareness on the role of digitalisation by building a narrative on digitalisation from a political perspective.
To do so, we propose the following actions:

- Co-create an overview of urgent political societal issues related to energy and how they are intertwined with various aspects of digitalisation of the energy system.
    - Co-creation (and dissemination) with VNG, policy advisors, deputies and ministers on the various related societal issues, relevant stakeholders from the energy sector, and stakeholders of the societal issue discussed, making sure to involve smaller entities.
    - Work with industrial designers for less technology driven and more intuitive visuals and narratives.
- Link to existing platforms for issues; for example, the well-developed cooperation for energy poverty (where various people from departments, VNG, CBS and TNO are working together)

Digital support \ Societal challenge	energy hubs in industrial areas	Grid conscious building and rennvation (houses)	Spatial planning	
Modelling/ digital twinning	✓	✓	✓	Commercial enterprises + Energy transition institute (proposed)
Reference architecture			✓	KPMG
Measuring in the grid	✓	✓	✓	Grid operators
	LAN	VNG LAN	IPO, VNG RES	

Abc: Parties involved

Fig. 5: A simplified illustration of how digitalisation and societal issues are linked, and which parties are/will be /should be working on it

Goals

Digitalisation of the energy system is no longer a distant topic that fails to resonate with politicians and administrators. Instead, it has become a well understood subject, with its opportunities and threats fully recognized, leading to a more appropriate sense of priority regarding the need for digitalisation .

Action Owner & supporting stakeholders

The Sustainable Scale-up Foundation, Waai.
Supporting stakeholder: the Province of Utrecht. In exploration with Vivet, a collaborative partnership that includes CBS and VNG.

Next steps

- Create a project plan
- Build a consortium
- Create a narrative

Deliverables / outcomes / measures

- A textual and visual overview of pressing societal issues with political urgency, highlighting the links to important topics on digitalisation of the energy transition. It also includes a summary of organizations actively working on these challenges.
- A comprehensive list of how digitalisation challenges or neglects can influence important societal themes.
- Examples from stakeholders(from big

Timeframe

2025 Q1 building consortium, getting funding
2025 Q2 start project
2025 Q4 first deliverables and communication
2026 Q1 final deliverables

<table>
<tr><td>factories to the water authorities) and which role/tasks/needs these stakeholders have, to highlight the importance.
• Meetings with relevant stakeholders from politics, administration and parties working on digitalisation and communication in the energy sector to create the above-mentioned overview of issues, links to digitalisation, list of problems, examples as input for the narrative for a communication strategy.
• A succinct communication strategy and first actions (±10 A4), that will be disclosed to all relevant parties.

The results should help officials understand and communicate the importance of digitalisation and its role in resolving societal issues. Furthermore, the results will allow them to create an increased sense of political urgency - and thereby budget - to work out challenges with regard to digitalisation.</td><td></td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No</td></tr>
<tr><td>Existing funding sources
None</td><td>Additional budget required
EUR 50.000 Sustainable Scale-up Foundation (e.g., meetings) and for Waai
Total max EUR 150.000 for 2025</td></tr>
<tr><td>Problem # mapping
Policy & Regulation: 104, 108, 112, 120, 122, 123
Human capital, education, awareness and workforce: 148, 152, 155
Resilient growth: 199, 200</td><td>Recommendations # mapping
Policy and Regulation: 1.2, 1.3
Human Capital, education, awareness, workforce: 3.2, 3.6, 3.7, 3.8
Resilient growth: 6.5, 6.6, 6.7</td></tr>
</table>

4.2.4 Baas in Eigen huiS (BIES)

Action Title: Boss In Own houSe/ Baas In Eigen huiS (BIES)	**Action #:** NL4
Action Owner: Sustainable Scale-up Foundation	**Action status:** Planning and looking for funding. Consortium has been formed

Action Objective / Description

Why: The Problem

As we transition to local energy communities powered by sustainable technologies, the complexity of these systems needs to be clear for residents. Residents face unexpected challenges in innovative housing projects such as climate-positive apartment buildings with solar panels, batteries, and heat pumps. Despite the promise of sustainability and cost savings, many residents have high electricity bills and experience frustration. Calling for a better match between technology, required knowledge and behaviour.

> Example use case:
> For example, in one award-winning apartment building, after three years of research, no one knows where the solar panels are connected or when the battery is charging—leading residents to assume the battery only benefits the business model of the battery owner, not the building itself. Residents also struggle with malfunctioning ventilation systems and heat pumps that take too long to warm up the space. When things go wrong, there is no clear responsibility for resolving these problems, and residents are bounced between various installation companies.

This lack of transparency and integration leads to frustration and, in many cases, disengagement from the energy transition.

How: The BIES Solution

BIES is designed to address these challenges by focusing on the needs of the residents. It provides a methodology and set of tools to ensure that residents can use new energy systems effectively and in a way that fits their lifestyle. By improving system integration, enhancing communication, and aligning technologies with user behavior, BIES makes energy systems more transparent and accessible. This approach will empower residents, including underrepresented groups, to use these systems and understand how they work.

BIES will also facilitate smoother integration of various sustainable technologies, ensuring users have the right tools to navigate their energy systems. It creates a clear responsibility structure, offering

residents a reliable point of contact when issues arise and ensuring that systems function as intended.

What: The Impact and Goals

The ultimate goal of BIES is to:

1. **Maximize the positive climate impact** during the user phase by ensuring that the expected benefits of the systems match the actual CO2 and cost-saving objectives while increasing residents' perceived comfort, understanding, and control.
2. **Accelerate the energy transition** by fostering greater trust and enthusiasm among residents. BIES will address negative experiences by offering clear, actionable solutions that help prevent residents from disengaging.

Through the application of BIES's methodology and tools, the project aims to:

- **Build trust**: Users, owners, and other stakeholders, including underrepresented groups, will have confidence in the new energy systems and will actively recommend them.
- **Improve alignment**: Technology will better match user behavior, leading to more accurate savings forecasts and increased user satisfaction.
- **Expand adoption**: Key stakeholders will be motivated to apply BIES's tools beyond the test locations, ensuring sustainability and potential further development of the tools.

The project will focus on building and renovation projects within the Netherlands, aiming to deliver a scalable solution for future developments.

Workline 1: Match user behaviour and technology
This workline looks at a user centric approach to new energy technologies. What is needed from the perspective of users/residents throughout the transition toward different systems (pre-building until user phase, or end of life) for the system to match their behaviour. For example, what are the requirements for the systems? What kind of information and communication is needed at which times and how to present it? Already a lot of research has been done on the adoption of new energy technologies by residents. However, this knowledge is not spread widely. In this workline, an overview will be created of best practices known from science and existing energy communities and cooperations. Gaps in knowledge will be identified and additional research done at several real life test/pilot locations where BIES partners are active. Behaviour interventions are designed.

Workline 2: Chain cooperation and innovation
The issues described in the introduction are not purely behavioural, many of them find their root in one or more of the following:

- lack of integration of technologies (they do not match)
- lack of clear agreements about how the technologies operate and who is responsible for integration and warranties, etc.

This workline focuses on designing and testing new work processes that help streamline collaboration between different parties. Moreover, in this workline, research will be done on which agreements are important to make from a user perspective. A playbook will be developed and tested in real life to aid municipalities, project developers, etc., to set the right requirements and facilitate the collaboration process. For example, we envision that in the transparency tooling (workline 3), red flags pop up if certain information important for the user is not filled out.

Workline 3: Transparency

We believe that experts and interested residents should be able to understand how the different parts of the energy system work (together), which stakeholders are responsible for maintenance, guarantees, etc. When they lack the overview, there will be a lack of trust in the system, and it will become impossible to tell a coherent story to those residents who do not want to understand, but only work with the system. Therefore, a digital tool will be created that fits with all existing software to create a joint digital representation of reality. Previously, we would have a bundle of drawings and contracts and nobody would have all of them, now we bundle the information, by integrating the drawings, summarise the agreements in the contracts, so all experts and interested residents can access the information for them. Similar systems have been developed in Finance and Health already.

Action supporting stakeholders

- TUDelft - University, behavioural research
- Met Verhoeven - building company
- Stichting Wiek-II - Energy corporation
- Twintopics - Software developer
- AMS institute - Transition Science Institute with living lab locations in Amsterdam

In exploration with:

- Alliander (DSO) +pilot location Balanswijk
- Bureau Objectief – designer of behavioural interventions
- Resourcefully - energy advisory company + initiator of pilot location
- NPRES - National institute for regional energy strategies, collaborates closely with all municipalities
- energy corporation Lunen
- Municipality Utrecht

Next steps

There is a Dutch consortium. All actions are focused on finding funding. The following two lines are tried:

- Finding EU consortium partners that are working on a cluster 5 Horizon proposal that the Dutch consortium can join.
- Unsolicited proposal for municipalities and provinces for a small budget for the first step of: providing an overview of the challenges local governments are facing with regards to grid congestion in the build environment and the developments with regards to “grid aware” building. By providing an overview of existing projects and the lessons learnt there (part of Workline 1), also outlining the issues that arise. The project outcome would include advice to municipalities and provinces on what role to take. One of the recommendations would be to co-fund BIES.

<table>
<tr><td>Deliverables / outcomes / measures
Result workline 1: A playbook with methods and tools to support residents in the use of the energy system and create a match between technology and behaviour. Dissemination of this knowledge to and through relevant parties.

Result workline 2: A playbook with methods and tools to support chain cooperations in building and renovation projects, leading to more transparency and trust in the system, and dissemination of this knowledge to and through relevant parties

Result work line 3: A user friendly system for experts or interested residents that provides transparency on all important aspects of the energy system (what, where, which agreements) visible to those who are entitled to see it (no energy flow data, it is not an energy management system).</td><td>Timeframe
Starting when funding is available. Duration 3-4 years.</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: Not required, but desired. We can reach a lot of large project developers and builders. However, if this really works, we feel all residents should benefit from properly integrated systems. Therefore, legal obligation to use some of the methods might be desirable.</td></tr>
<tr><td>Existing funding sources
There are discussions with private parties about (partial) funding of the software component.</td><td>Additional budget required
The entire project needs to be funded. We estimate to roughly need €3-3,5 million for the completion of the entire project. Approximately € 1.000.000 of the total budget is reserved for building software to build a shared digital view of reality. Splitting the total project in several smaller projects/stages is also an option.</td></tr>
<tr><td>Problem # mapping
Human capital: education, awareness, workforce: 144
Technology adaptation and deployment: 172, 173
Resilient growth: 201</td><td>Recommendations # mapping
Human Capital, education, awareness, workforce: 3.7, 3.8
Technology, adaptation and deployment: 4.2
Ecosystem connectivity: 5.2
Resilient growth: 6.3, 6.4</td></tr>
</table>

4.2.5 Benefit for Balance

Action Title: Benefit for Balance (BfB)	**Action #:** NL5
Action Owner: Unify.energy	**Action status:** Pilot phase completed in 2023, in Rotterdam.

Action Objective / Description

'The problem lies not in the grid, but in the market mechanism'. Benefit for Balance is an initiative designed to help households, SMEs and collectives reduce their dependence on regional and national energy grids by incentivising to improve local energy balance. Benefit for Balance stimulates prosumers to maximise their use of local renewable sources, like solar panels, before relying on the grid.

Why and what

Benefit for Balance was initiated by Unify from the hypothesis that as long as deficits between supply and demand would define energy price, the market will always be incentivised to increase imbalance, resulting in gaming the market, needless extra investments in grid capacity to accommodate peak transport, and higher commodity prices for the user.

Benefit for Balance introduces a new market mechanism for local energy systems and communities, where the member can then be awarded for their real-time contributions to the balance of the whole, resulting in less grid dependencies, lower grid cost, better energy autonomy and local cohesion as users together can improve the balance of their entire neighborhood, resulting in better functioning local energy systems.

With the increase of availability and affordability of local storage solutions (compound annual market growth rate >100%), Benefit for Balance becomes a realistic option for local energy communities and energy hubs, allowing them to organise their own local market mechanisms instead of being subject to the volatilities of the national and European spot and imbalance markets.

The Benefit for Balance algorithm prioritises energy sharing within local communities, enhancing the efficiency of energy distribution and minimising strain on larger infrastructure. This approach not only allows participants to cut their electricity usage by up to 45%, but also enables them to be independent of the grid up to 51% of the time. On average, this independence could save each household up to EUR 500 annually in energy costs. When executed at scale, the savings potential potentially amounts to tens of billions of euros in The Netherlands, based on the € 200bn+ projected investment in grid reinforcement that would then partially be made obsolete. This algorithm can be integrated with existing energy sharing protocols like S2, and also be further developed into a multi-carrier energy sharing protocol for local energy systems (individual and collective), integrating exchange and improving balance over 3 energy modalities: electricity, heat and molecules.

Benefit for Balance is a potential game changer for the integration of energy storage on local and individual energy systems, as its design incentivizes the users to keep renewable generated energy local instead of using the already congested grid as a virtual battery.

<table>
<tr><td colspan="2">Further development of BfB leads the way to an integrated solution that optimises local energy autonomy and minimises the load on the grid while lowering energy bills. Grid balancing no longer is the sole responsibility of the grid operator, but starts behind the meter, at home, and at the benefit of the individual user.</td></tr>
<tr><td>Action supporting stakeholders
Municipality of Rotterdam - previous contributor and supporter

A coalition including UX, machine learning and AI specialists is needed to bring Benefit for Balance to the next level.</td><td>Next steps

• Pilot Expansion (€2.5M, 12-18 months): Test BfB and IoT tools in 2-3 pilot communities to validate dynamic pricing, reducing net dependency (up to 45%) and user costs (up to €500/year).
• Regulatory Engagement (€500K, 6-12 months): Advocate tax incentives for local energy use through workshops with policymakers and align regulations with EU directives.
• User Awareness (€1M, 12-24 months): Educate users through campaigns, guides, and a basic app for monitoring savings and incentives.

Desired outcome: Proof of concept, regulatory support, and user engagement to reduce energy costs and dependency, enabling nationwide adoption.</td></tr>
<tr><td>Deliverables / outcomes / measures
• Reduce grid dependency of participating households and SMEs by up at least 45%.
• Enable up to 51% independence from the grid or more.
• Potential annual savings of up to EUR 500 per household or more.</td><td>Timeframe
Q2 2025 bridge funding
Growth capital: 2025-2027</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No</td></tr>
<tr><td>Existing funding sources
The municipality of Rotterdam subsidized the project in 2023 with EUR 100k. An additional € 100k was provided in kind by Unify. There is no new funding or current funding in the project.</td><td>Additional budget required
An additional 4M funding will be needed in 2025 for next steps mentioned above..</td></tr>
</table>

Problem # mapping	**Recommendations # mapping**
Human capital, education, awareness, workforce: 144, 145 Technology adaptation and deployment: 159, 164, 165	Human Capital, education, awareness, workforce: 3.8 Technology, adaptation and deployment: 4.2, Resilient growth: 6.3, 6.4

4.2.6 KIck off FLexibility INteroperability (KIFLIN)

<table>
<tr><td colspan="2">Action Title: KIFLIN - KIck off FLexibility INteroperability</td><td>Action #: NL6</td></tr>
<tr><td colspan="2">Action Owner: TNO</td><td>Action status: The project started at the end of 2024 and has a duration of 1.5 years.</td></tr>
<tr><td colspan="3">Action Objective / Description
The S2 standard (EN 50491-12-2) describes a future-proof approach to exploit energy flexibility, but adoption in the market is currently lacking. Making a mature technical implementation of the S2 standard together with an EMS party and a hardware manufacturer, kick-starts an ecosystem where both sides of the S2 protocol have products that are commercially available.

In addition, resources and tooling are being developed to make implementing S2 easier for everyone who needs it.</td></tr>
<tr><td colspan="2">Action supporting stakeholders
The consortium consists of TNO, Seita and Itho Daalderop</td><td>Next steps
Start implementation of S2 protocol in EMS and back-end of device manufacturer</td></tr>
<tr><td colspan="2">Deliverables / outcomes / measures
Mature S2 implementation in Seita's open-source EMS and the heat pumps and/or boilers from Itho Daalderop. In addition, publicly available resources and tooling for it implementing S2.</td><td>Timeframe
The project started in Q4 2024 and has a duration of 1.5 years</td></tr>
<tr><td colspan="3">Policy / Regulatory change required?: Yes. It is now unclear for device manufacturers and EMS providers how the two interact with each other to communicate, several options are possible, including S2. Because there is no policy in this area, adoption and scalability of solutions that exploit energy flexibility behind the metre is difficult. This hinders the growth of this market and its application of this technology on a large scale for, for example, grid congestion.</td></tr>
<tr><td colspan="2">Existing funding sources
Subsidy from RVO and own resources from project partners</td><td>Additional budget required
No</td></tr>
<tr><td colspan="2">Problem # mapping
Policy & Regulations 104, 107, 116, 117
Technology adaptation and deployment: 167
Resilient growth: 195, 196, 197</td><td>Recommendations # mapping
Policy and Regulations: 1.5, 1.6, 1.7
Technology, adaptation and deployment: 4.1</td></tr>
</table>

4.2.7 Path to Zero 2.0 - the way to collective energy autonomy

Action Title: Path to Zero 2.0 - the way to collective energy autonomy	**Action #:** NL7
Action Owner: Unify.energy	**Action status:** Ideation, concept development

Action Objective / Description

The energy company for tomorrow earns more as it sells less energy. At the core of this innovation lies an integrated energy solution: instead of focusing on energy volumes to purchase on the wholesale market with the intent to resell them to the customer at a margin, this energy company regards energy as a service that can very well be provided by the customers themselves.

The solution includes a different business model for energy companies, where no margin is added to the supply of energy, but profits are earned per step on the Path to Zero. This includes financing solutions for energy efficiency, generation and energy management out of the build-up of savings from each previous step on the customer's Path to Zero.

Every customer has an interface that continuously calculates the next best step towards their own energy independence, based on user data, energy data, building data etc. The supplier charges their customer a flat fee, based on net expenses on energy purchase, which would decrease over time as a result of installed solutions on the Path to Zero. The financial headroom created with this solution acts like a revolving personal energy transition fund, which can then be invested into the customer's next best step on their energy transition, thereby increasing the speed at which energy independence is reached.

The Path to Zero fee is continuously invested in improving the customer's energy independence, always choosing the next best step towards energy independence: energy efficiency solutions, as well as energy generation and storage. This results in a user-friendly solution that naturally incentivises clients to improve their energy independence, and structurally reduce usage and expenditures on energy from external suppliers. In 2010 we already proved the concept of an energy company in The Netherlands -BAS (Beneficial to All Stakeholders)- that introduced a radical new business model: earning more as we would sell less energy. Over time customers became more and more independent, averaging 30% less energy purchased by an average customer after 4 years on this program. Although the solution was sound, and the business model was awarded by MIT in 2014, the Path to Zero was too early for the market, and BAS' adventure ended in 2016.

Why and what

We believe that now Europe's energy system has reached momentum for re-introduction of a further improved Path to Zero, especially against the backdrop of the volatility of energy prices since the start of the Russian war in Ukraine, and deterioration of security of energy supply due to congested grids.

<table>
<tr><td colspan="2">What we propose is the development of an open source platform and user interface that enables energy users to turn their energy bill into a manageable revolving fund for their own energy transition: the Path to Zero 2.0. This platform makes use of the rationale developed in 2010, but further improved. This means that it does not only serve individual users, but is tailored to serve collectives, cooperatives, energy communities and energy hubs. By integrating digital twin solutions with the Path to Zero and offering an interface to optimise the effectiveness of investments, the Path to Zero can evolve into a broadly used solution for European households, businesses and overarching collectives to structurally improve their energy autonomy, whilst decongesting the grids. By adding the collective service offering, investments in collective and commonized assets can also be done and managed: neighborhood batteries, EV-infrastructure, collective solar fields, etc.

The Path to Zero 2.0 can function as an independent platform, but also be adopted by energy supply companies and energy service companies throughout Europe and integrated with their proposition, in order to improve the energy autonomy of a broad spectrum of European energy users</td></tr>
<tr><td>Action supporting stakeholders
Unify energy - Arash Aazami
YesAndMore - Lieven Callewaert
We seek collaborations with data specialists, platform developers, UI/UX experts, and energy production & supply companies.</td><td>Next steps
Raise funding and develop the platform. The estimate is a required € 350.000 for proof of concept and pilot-ready software, and another € 1,5 million to develop a 1.0 version market ready product that can be implemented on regional markets or integrated with the user interface of energy companies.</td></tr>
<tr><td>Deliverables / outcomes / measures
The product is a platform and application for individual users, cooperatives, energy communities and energy hubs, and can also be offered as an add-on to the service offering of energy companies.</td><td>Timeframe
Desired start in Q2 2025</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No: Since the introduction of the European regulation on electricity market reform no policy change is required, provided that member states will implement energy sharing in their polices.</td></tr>
<tr><td>Existing funding sources
No current funding</td><td>Additional budget required
Needed for product development and rollout</td></tr>
<tr><td>Problem # mapping
Human capital, education, awareness and workforce: 144, 146
Technology, adaptation, and deployment: 172</td><td>Recommendations # mapping
Human Capital, education, awareness, workforce: 3.7
Technology, adaptation and deployment: 4.2
Resilient growth: 6.3, 6.4</td></tr>
</table>

4.2.8 Open Heat NL

<table>
<tr><td>Action Title: Open Heat NL</td><td>Action #: NL8</td></tr>
<tr><td>Action Owner: TNO</td><td>Action status: Project plan submitted for review for grant award (first of the rest)</td></tr>
<tr><td colspan="2">Action Objective / Description
Current solutions for exploiting energy flexibility in households have limited interoperability, reducing the ability to scale the ecosystem significantly. Defining an open ecosystem (where participants work together on interoperability instead of creating a vendor lock-in or verticals. E.g. A heat pump from one manufacturer can also work with an energy management system (EMS) from another manufacturer) for deploying energy flexibility of climate systems (such as heat pumps and boilers) to support the energy system (balancing supply and demand and congestion management). This involves all relevant stakeholders. It looks, in particular, at technical interoperability and systems, but also at the business ecosystem and user behaviour.</td></tr>
<tr><td>Action supporting stakeholders
The consortium consists of knowledge institutes (led by TNO), energy management system (EMS) parties, heat pump/boiler manufacturers and building owners. Energy suppliers and grid operators are also involved.</td><td>Next steps
Awaiting assessment by governmental funding organisation.</td></tr>
<tr><td>Deliverables / outcomes / measures
Insights into the energy flexibility ecosystem and concrete technical solutions to make different systems in the ecosystem work together</td><td>Timeframe
If accepted, the project will start in 2025 and run for 3 years</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: Yes, it could be that regulation could help with the adoption of the project's results (think of encouraging the use of certain protocols).</td></tr>
<tr><td>Existing funding sources
Grant from RFO and own funds from project partners</td><td>Additional budget required
Not for now, the project has yet to start</td></tr>
<tr><td>Problem # mapping
Ecosystem connectivity: 178, 181
Resilient growth: 194, 195</td><td>Recommendations # mapping
Ecosystem connectivity: 5.2</td></tr>
</table>

4.2.9 Synergy energy innovation program

Action Title: Synergy energy innovation program	**Action #:** NL9
Action Owner: Unify.energy	**Action status:** Synergy launched in 2023 as a hackathon and now evolves into a year-round program for an expanding ecosystem. Launch of the Synergy ecosystem is planned in Q1 2025.

Action Objective / Description
Synergy began as a hackathon to drive systemic innovation in the energy transition. In 2024, Synergy hosted 200 participants in Delft, NL, for a 48-hour innovation sprint. 21 teams from various backgrounds participated, conceptualized and developed actionable solutions, leading to multiple startup formations.

Why and what:
Key learning: Maintaining momentum post-event requires year-round structures: innovators need continuous matchmaking, mentoring, and regular engagement. Corporate and governmental partners, while supportive, lack the capacity to incubate or accelerate projects independently.

Objective: Synergy will transition into a continuous innovation ecosystem, connecting change-makers with partners, investors, and a talent pool. The program addresses needs across technology, business models, social frameworks, and institutional structures.

Stakeholder Needs:

- **Corporate Partners:** Seek transformative solutions, human capital access, and inspiration.
- **Governments:** Need system-wide awareness and better frameworks for policy innovation.
- **Users/Prosumers:** Demand accessible, reliable, and affordable energy systems.
- **Investors:** Require clarity on opportunities for high-impact, sustainable returns.
- **Innovators:** Need context, connections, and resources to accelerate solutions.

Program Vision (2025-2027):

Synergy will evolve into a vibrant ecosystem with:

1. An accessible repository for APIs, protocols, and standards.
2. Data-sharing tools for collaboration.
3. A platform to support networking, knowledge sharing, and talent matchmaking.
4. An expanding array of Synergy events, C-suite strategic meetups, deep dives, partner events
5. A replicable model to be executed in a growing number of European countries

<table>
<tr>
<td>Action supporting stakeholders
Synergy in 2024 was supported by Alliander (grid operator), Essent and Vattenfall (energy supply), Dockwize (govt. - regional investment organisation), Antea (engineering), TU Delft (university), Provincie Zuid Holland (govt), municipalities of The Hague and Utrecht.

For the ecosystem we seek support of more partners and are now conducting meetings with various companies and public organisations. Synergy also seeks to partner with event organisations and festivals and currently discusses collaborations with Eurosonic Noorderslag Festival, Upstream Festival, Superconnectors and more.</td>
<td>Next steps

1. Securing Commitments:

• Corporate Partners:
○ Develop tailored value propositions (e.g., showcasing ROI and impact opportunities) for partners.
○ Organize partner roundtables in Q1 2024 to secure letters of intent.
• Public Funding:
○ Align proposals with EU/NL energy transition programs (e.g., Horizon Europe).
○ Apply for regional innovation grants by Q2 2024.

2. Program Development:

• Partner events: Establish.collaborations with partnering events as of Q4 2024.
• Hackathon 2025: Launch preparation (team recruitment, sponsorship) by Q2 2025.

3. Stakeholder Engagement:

• Expand the partner network by finalizing agreements with public and private stakeholders..
• Launch a communications campaign in Q1 2025 to grow visibility and expand the ecosystem.</td>
</tr>
<tr>
<td>Deliverables / outcomes / measures</td>
<td>Timeframe
2025-2027</td>
</tr>
<tr>
<td colspan="2">Policy / Regulatory change required?: No</td>
</tr>
<tr>
<td>Existing funding sources
Partners, members, challenge owners, in kind contributors. Synergy raised € 180.000 and +/- €</td>
<td>Additional budget required

Proposed Budget (2025-2027):</td>
</tr>
</table>

50.000 in in kind contributions during Q4 2023-Q1 2024 for the first Synergy hackathon, held in February 2024.	1. **2025 Minimum Budget:** €300,000. ○ **Breakdown:** ■ €50,000: Repository development (MVP). ■ €130,000: Program operations (staff, logistics, mentoring, and events). ■ €120,000: Hackathon organization (Q4 2025) and partner events. 2. **Total 3-Year Budget (2025-2027):** €1.3 million. ○ 50% to be secured from corporate partners (~€650,000). ○ Remaining from public funding, event revenues, and in-kind contributions.
Problem # mapping Policy and Regulations: 110, 112 Market state and funding: 131, 135 Technology, adaptation and deployment: 166, 167, 168, 169 Ecosystem connectivity: 174, 175 Resilient growth: 194, 195, 197	**Recommendations # mapping** Policy and Regulations: 1.4, 1.5, 1.7 Market state and funding: 2.5 Technology, adaptation and deployment: 4.1 Ecosystem connectivity: 5.1, 5.2 Resilient growth: 6.4

4.2.10 Esilience serious game

Action Title: Esilience serious game	**Action #:** NL10
Action Owner: Zerow BV	**Action status:** Concept & planning ready. Team formed. First test group confirmed. Currently seeking funding, to start implementation of the first phase (Develop and test Proof of Concept).

Action Objective / Description

Why:

The energy transition requires faster, more collaborative decision-making at the local level to build effective, sustainable energy communities. However, local stakeholders often face barriers due to a lack of understanding or motivation, as well as the complexity of designing energy systems that align with community needs. There is a need for innovative approaches to engage local communities in the energy transition process and empower them to take ownership of their energy future.

How:

Esilience will address these challenges by developing a serious game and workshop concept designed to foster collective decision-making within regional and local energy communities. The game will offer an intuitive and accessible interface that integrates both the social complexity of community motivations and the technical complexity of local energy systems. By combining local data and diverse player perspectives, Esilience creates a more realistic and engaging environment that supports informed decision-making. This will help to kickstart conversations and create a more collaborative and motivated atmosphere for designing local energy solutions.

What:

Esilience offers a serious game and workshop framework that will engage local stakeholders in a hands-on, interactive experience, enabling them to actively participate in designing their community's energy systems. The game will balance social and technical complexities, making it easier for participants to understand and navigate the challenges of energy system design. The expected outcome is increased community engagement and a higher level of motivation and acceptance when it comes to jointly shaping the future energy setup for their local area, accelerating the energy transition.

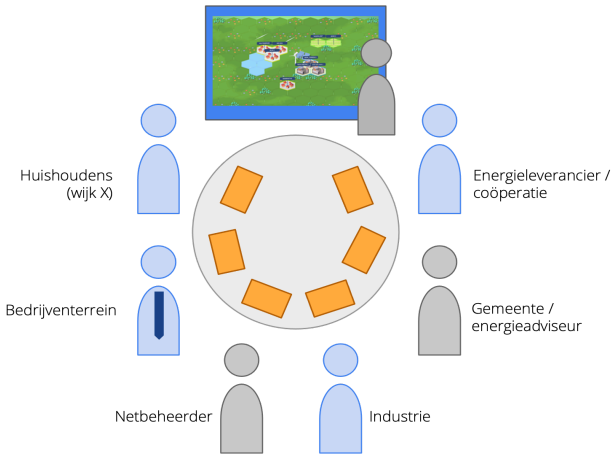

Figure 6. Example setup of an esilience workshop: players are present in one physical space, with individual access to the digital game on a tablet or laptop

Action supporting stakeholders When sufficient funding becomes available, we plan to establish a foundation (stichting), enabling us to upscale our esilience efforts without commercial intent and contribute to the public good by faster and more effective energy transitions. **Confirmed:** Zerow BV (project lead, development) Studio Holon (concepting and user group testing) Provincie Overijssel (enabler for upscaling to other municipalities within region) **In exploration with:** KplusV (concepting and user group testing) Netbeheer Nederland (financial sponsor, network with "netbeheerders") **Potential other stakeholders:** Ranking high on our wishlist is Zenmo (enabling more complex/realistic energy system calculations in game engine)	**Next steps** Identify and acquire funding (i.e. EUR 20-30k) to initiate the first phase of the project – develop and test Proof of Concept.
Deliverables / outcomes / measures **First phase – Proof of Concept** A basic prototype serious game, (1) demonstrating the core functionalities and (2) validating initial signs from the test user group that the game leads to effective collective and	**Timeframe** Start February 2025 (or when funding available) + four months developing and testing End approx. June/July 2025

<table>
<tr><td>individual insights into how the energy transition in the local community can be designed.

Second phase – Market entry preparation and Advanced Prototype
Develop a second – more advanced – prototype game, (1) demonstrating more functionalities compared to the basic prototype, and (2) validating with five other test groups whether it meets the defined goals. These test groups will be more heterogeneous.
In addition – prepare market entry, set up business model for sustainable operations after development, reach out to potential clients (e.g. municipalities, “bedrijventerreinen”, etc.), organisers (e.g. “netbeheerder”, provinces) and facilitators (e.g. energy advisors) to ensure a sustainable usage of the final product.

Third phase – Final Product development, delivery, market entry
Final product development. Delivery and communication to stakeholders.
Execute business model (e.g., product communication/knowledge, maintenance/updates, tech support)</td><td></td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No</td></tr>
<tr><td>Existing funding sources
Netbeheer Nederland (EUR 5k – could become more; usage condition is that other entities also fund this initiative)

Additional info: Approximately 25kEUR has already been invested to generate the current plan and current, partially in cash by Netbeheer Nederland (5kEUR) and by several key members of the project team (incl. Provincie Overijssel) valued at approx. 20kEUR.</td><td>Additional budget required
Phase 1 – EUR 20-25k
Phase 2 – EUR 80-120k
Phase 3 – EUR 100-200k</td></tr>
<tr><td>Problem # mapping
Human Capital, education, awareness, workforce: 144, 145, 154
Technology, adaptation and deployment: 171, 172</td><td>Recommendations # mapping
Human Capital, education, awareness, workforce: 3.8
Technology, adaptation and deployment: 4.2
Resilient growth: 6.3</td></tr>
</table>

4.2.11 Facilitating Collaboration and Data Sharing

Action Title: Facilitating Collaboration and Data Sharing	**Action #:** NL11
Action Owner: Sustainable Scale-up Foundation	**Action status:** Pilot projects with stakeholders based on proven MVPs (services in specific application areas to build user cases).

Action Objective / Description

Why

To overcome the problems addressed, collaboration between various stakeholders is essential. This already is a challenge itself, but collaboration on data -a condition for future-oriented collaboration- is currently virtually impossible in the energy sector. We require more than simply exchanging data, and securing the exchanged data to be used only for its intended use is impossible.

The biggest problem here is the fragmentation of data and systems. Partners store data in different systems and databases, leading to inefficiencies, duplication of work and the risk of errors because of the lack of data consistency and accuracy. This problem is exacerbated by the variety of data required for different aspects of the energy transition that are not covered by the data sources of the individual partners.

How

We require a new approach for data collaboration: a common workspace with a shared single point of truth, while individual partners who legally own the data control the data itself. Artificial Intelligence, Blockchain technology, and data security must be combined to create a single point of shared truth so consortium partners can act on it for the required results in the energy transition.

A consortium of leading European tech companies develops comprehensive guidelines and tools -based on dynamic modelling, a proven approach in multiple sectors[22]- to foster effective collaboration and data sharing. This initiative unites diverse actors, disciplines, sectors, and regions, aligning their objectives to build a more resilient and autonomous energy infrastructure across Europe and developing a framework for seamless future-oriented collaboration. This collaborative approach tackles today's most pressing challenge in the energy sector: data integrity (!) and fragmentation. By addressing this issue, the consortium promotes the interoperability of data and systems, enabling diverse stakeholders to exchange information across boundaries while maintaining system integrity efficiently.

[22] Dynamic modelling combines object and process modelling to obtain a real-time holistic view of complex systems. This approach has significantly simplified the mortgage process (70% of banks work with this), and is the basis of the electronic patient file (50% of healthcare providers work with this) and the student tracking system (between 51-96% of basic - and secondary schools work with this).

<table>
<tr><td colspan="2">What
Currently the consortium of leading European tech companies is working and exploiting these comprehensive guidelines and tools for the build environment. The model used needs to be extended with the necessary dynamic data model(s) necessary for the energy transition in combination with API to unclose data sources of the partners that are willing to collaborate. This in such a manner that easily new partners can join the collaboration..</td></tr>
<tr><td>Action supporting stakeholders
A consortium of nine Dutch Tech companies such as Avento Group, Baseflow, TwinTopics, Bee4GIS, Bee4BIM and stakeholders of which the Sustainable Scale-up Foundation is the secretary.</td><td>Next steps
Start a pilot project in region Twente to create a common workspace with a shared digital view of reality, and gradually expand the outcomes to other regions.</td></tr>
<tr><td>Deliverables / outcomes / measures
A common workspace with a shared digital view of reality, consisting of:
A Shared Data Layer: an advanced data repository where all data is collected, validated, managed and secured. This ensures that all parties involved have access to the same reliable data. It requires a standardised approach to data collection and management and advanced data integration and validation technologies.
A Shared Workspace: a collaborative digital workspace, enabling each party to work with not only their own models, tools and data sources but also the models, tools and data from the consortium, towards distinct goals. This setup allows mutual data creation and validation, expanding the Shared Data Layer where participants can connect their systems and engage with value chain partners in forward-looking management. We use APIs and microservices to integrate and exchange data from different sources (data integration and interoperability).
A Shared Digital (4D) View: a virtual representation of the built environment (outside, inside, underground and the shell) integrating real-time data from various sources to provide a holistic overview of energy processes and infrastructure. We will use DCW, BIG models (Fibre, Electricity Grid, Sewer, etc.), Geo maps and all lidar/point cloud technology forms in one Shared and tool-independent Knowledge Graph based</td><td>Timeframe
May 2025 - May 2028</td></tr>
</table>

on international open IFC standards.	
Policy / Regulatory change required?: No	
Existing funding sources YES - the consortium invested EUR 3.000.000.	**Additional budget required** YES - EUR 7.000.000 (EUR 3.000.000 requested by EU Horizon and Investors, TBD)
Problem # mapping Policy and Regulations: 103 Technology adaptation and deployment: 170 Ecosystem connectivity: 178, 181 Resilient Growth: 190, 191, 195, 196, 197	**Recommendations # mapping** Policy and regulations: 1.5, 1.6, 1.8 Technology adaptation deployment: : 4.4 Ecosystem connectivity: 5.1, 5.2 Resilient growth: 6.5, 6.6

4.2.12 Chart the Course to a Decentralized Energy Economy

Action title: Chart the Course to a Decentralized Energy Economy	**Action #:** NL12
Action Owner: Power of the Many	**Action status:** Seeking growth capital

Action Objective / Description

Empowering the energy transition by fostering collaboration across the value chain, driving the development of energy hubs and communities, and enabling the organic growth of a decentralized energy economy that is resilient, equitable, and accessible

A decentralized energy system requires a decentralized market

Current energy markets block the shift to decentralized systems. To unlock their full potential—resilience, equity, accessibility, energy autonomy, and net-zero progress—they must be paired with a decentralized energy economy within a framework that enables autonomous energy communities and hubs to trade power, balance the grid, and achieve sustainability.

Achieving this transformation implies a journey to a market system that is secure, inclusive, and transparent. It must onboard residents, businesses, energy hubs, communities, and even nations in a step-by-step transition from centralised to decentralised models. Such a system must adhere to security and privacy by design principles, enable democratic governance, and incentivize behaviours aligned with sustainability and net-zero goals. This is not just about transforming market mechanisms, but also about fundamentally shifting how energy economies are built, grown, and governed.

Enabling a bottom -up, non disruptive transition

A decentralised energy economy must grow organically, from the ground up, to fully meet the needs and aspirations of its participants. This bottom-up approach fosters local ownership, innovation, and adaptability. Residents, businesses, and communities should be able to actively participate in shaping the system, ensuring it reflects their priorities while avoiding the pitfalls of top-down imposition, which often fails to account for local needs and complexities.

In such an economy, **transparency and trust** are foundational. With many autonomous actors participating in decentralized markets, stakeholders need a system that ensures:

- **Transparency**: Clear visibility into market operations, energy flows, and governance decisions to build confidence and accountability in data-sharing-secure transactions and

data-sharing mechanisms that remove the need for centralized intermediaries and fosters equitable participation.

- **Trust**: Secure mechanisms for transactions and data sharing that remove the need for centralized intermediaries and foster equitable participation.

This requires a robust framework to digitise and trade value seamlessly. Energy and related rights—such as the ability to trade kilowatt-hours, access demand-response services, or a share in a renewable infrastructure—should be easily transferable. A framework that enables participation at all levels while ensuring data protection and encouraging sustainable behaviors. .

Blockchain is inherently well-equipped to decentralise the energy market because it enables secure, transparent, and tamper-proof transactions without relying on intermediaries. Its ability to tokenise (digitise) any value—such as a share in a solar park, a kilowatt-hour of energy, or the right to vote on a wind turbine investment—facilitates seamless trading and collaboration. This capability fosters inclusivity, empowers participants to actively shape the energy economy, and drives the transition toward a resilient and equitable decentralized system.

By allowing the decentralised market system to evolve alongside the existing centralized market, blockchain and tokenisation offer a non-disruptive transition path. This parallel growth reduces systemic shocks and resistance to change, ensuring that as decentralized markets expand, the centralized system can naturally phase out in alignment with technological, economic, and societal readiness.

Building Micro-Energy Economies for a Decentralized Energy Future

Power of the Many plays a crucial role as the orchestrator in this transformation, uniting and empowering all its stakeholders. Acting as a project development agency, it bridges solution providers, technology experts, and knowledge partners, ensuring collaboration and alignment to drive the creation of energy economies; hubs and communities, by leveraging the transformational and inherent qualities of blockchain technology as the perfect means for the goal.

Power of the Many's activities include:

- **Facilitating Collaboration Across the Value Chain**: By acting as a central orchestrator, Power of the Many connects all stakeholders—energy producers, technology providers, communities, cooperatives, and regulators—ensuring alignment and cooperation effectively. This collaboration is vital for developing and deploying energy hubs and communities effectively.
- **Building Integrated Solutions**: Leveraging blockchain-based tokenization, digital twin technology, and asset digitization to create self-sustaining energy hubs and communities that can operate autonomously while contributing to broader market stability.

- **Establishing Transparent and Trustworthy Frameworks**: Developing governance models and operational standards that ensure transparency and trust throughout the value chain, encouraging participation from diverse actors.
- **Driving Organic Growth**: Power of the Many will develop the energy economy incrementally, **hub by hub, community by community, node by node**. Each energy node will act as a building block, autonomously growing and connecting into a larger decentralized network. This approach ensures local adaptation and scalability while maintaining a cohesive and interoperable system. As each node matures, it catalyzes further growth, spreading the decentralized economy sustainably and inclusively.
- **Open Source Repository**: Data, files, or other resources are stored, managed, and organized for access, sharing, or analysis and accessible to stakeholders
- **Ongoing Support**: Offering project management and long-term support to ensure hubs & communities remain resilient, adaptable, and aligned with the overarching energy transition goals.

Power of the Many aims to be an essential hub driving the energy transition, leveraging digitisation, decentralisation, and collaboration to enable energy hubs, communities and their stakeholders **to participate in or build their own micro-energy economies**, all while collaborating effectively to shape a decentralised energy economy.

Action supporting stakeholders	**Next steps**
• Quadruple Helix • Partners: Llqwith, Sunified, Bausch Datacom, RDDL.io, EnergyBlocks, HyphaEnergy	• Grow team to support pilot projects in the pipeline • Create a learning environment and framework for an multi-stakeholder repository
Deliverables/outcomes / measures • Becoming a lighthouse for the development of (micro)energy economies. • Empowering the energy transition by fostering collaboration across the value chain • Driving the development of tokenized energy hubs and communities, and enabling a decentralized energy economy that is resilient, equitable, and accessible. Deliverables: • Value chain collaboration • Successful energy hubs, communities, and open source repository	**Timeframe** Q1: Start Developing an agency governed by 2Tokens Foundation. Q2-Q4 2025: Grow team, kick-off 3- 5 new pilot projects. Develop repository framework Y 2026: 5-10 successful projects realized Y 2027: Scaling impact with project development and opening access to the repository.

<table>
<tr><td>Measures:
A growing number of successful pilots, energy hubs, energy communities and engaged prosumers building a decentralised energy economy</td><td></td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: Policy Frameworks like the Renewable Energy Directive should be expanded to support peer-to-peer trading and innovation pilots. Collaboration across municipalities, industries, and communities is vital to address energy poverty and resilience challenges, advancing sustainability goals effectively</td></tr>
<tr><td>Existing funding sources
30% partner funding
30% grants
30% consultancy/ educational program</td><td>Additional budget required
Phase 1
€ 350k to grow the team, yield the pipeline, and run 3-5 pilot projects
€ 300k - 500k (depending on specs first milestone) Design framework open repository and collaboration platform</td></tr>
<tr><td>Problem # mapping
Policy and regulations: 115, 119, 121, 125
Market state and funding: 137
Technology adaptation and deployment: 164
Ecosystem connectivity: 181
Resilient growth: 191</td><td>Recommendations # mapping
Policy and regulations: 1.9, 2.5, 4.3
Market state and funding: 2.5
Technology, Adaptation and Deployment: 4.3</td></tr>
</table>

5. Hungary

5.1 Hungary Ecosystem Analysis: Key Problems & Recommendations

Hungary faces complex challenges in its energy transition, including low consumer engagement, insufficient infrastructure, and policies that stifle energy efficiency efforts. Electricity consumption is dominated by residential users, with administratively set, artificially low prices for all households reducing incentives for conservation. During the energy crisis of 2022-2023, the government has introduced volumetric caps on subsidised household electricity and gas consumption and set prohibitive natural gas and doubled electricity prices above them respectively. Residential gas consumption fell by 25.2% between 2021 and 2023 demonstrating the untapped potential in savings and efficiency measures. The crisis also spurred significant residential photovoltaic (PV) installations, with solar energy production rising very steeply and accounting for 18.7% of electricity production in 2023. For the time being Hungary has one of the highest solar PV capacity relative to its peak electricity demand (ratio above 1, at peak solar production it exceeds domestic demand) in the EU, testing new frontiers in network flexibility. Consequently, rapid PV growth has stressed the grid, causing imbalances and frequent zero or negative price intervals on the electricity exchange.

Grid integration challenges are compounded by undercapitalised distribution system operators (DSOs), which lack funding due to reduced household utility tariffs and limited state or EU financial support. Smart meter adoption is also lagging, with only 17% penetration compared to the EU average of 54% in 2021, underscoring the need for accelerated deployment to meet EU targets.

This section offers an analysis of the primary challenges across these domains, linking each with targeted actions and recommendations.

5.1.1 Policy & Regulation

The lack of an integrated digitalisation strategy has resulted in slow legislative adaptation, impeding innovation and delaying reforms necessary for developing smart energy systems. Low electricity tariffs in the household sector disincentivize digitalization, while rapid solar capacity developments left no time for adaptation for the stakeholders. The situation looks somewhat better in the industrial and business segments, where electricity prices are very high in an EU comparison. Lack of network flexibility and oversized solar capacity have become the main drivers for digitalization only recently. Current

energy network tariffs make green energy financially unfeasible, requiring revision to encourage renewable adoption. Challenges such as the absence of effectively operating regulatory sandboxes, lengthy permitting processes, and limited testing facilities such as field labs hinder innovation activity. Additionally, energy sharing issues and market entry barriers restrict the growth of energy communities and flexibility providers, further complicating the energy transition.

The regulatory environment remains fragmented, lacking alignment between renewable energy, digitalisation, and energy efficiency goals. While nuclear power reduces carbon emissions, it limits diversification of the energy mix. Subsidised energy prices disincentive energy-saving behaviours and renewable adoption, exacerbating inefficiencies.

5.1.2 Market and Funding

The current tariff system, with fixed fees for households and high network usage fees for industry, is particularly unfavourable for investments related to RES, energy efficiency or digitalisation. Additionally, the limited capacity and financial stability of distribution system operators (DSOs) hinder the development of modernised grid infrastructure, which is critical for integrating renewable energy and improving system flexibility. This creates a bottleneck for scaling renewable solutions. Market structures are insufficiently incentivised to promote energy communities, further impeding the adoption of decentralised energy systems that could alleviate strain on the central grid

Local governance also faces challenges in implementing clean energy initiatives due to resource constraints and limited technical expertise, particularly in rural regions where energy efficiency measures and renewable energy projects are underdeveloped. These gaps leave Hungary trailing its European counterparts in transitioning to a resilient and flexible energy system.

5.1.3 Human Capital

Public awareness is another critical challenge. Historical dependence on subsidised energy prices has created resistance to adopting renewable energy and energy-efficient behaviours. Without targeted awareness campaigns and educational initiatives, societal engagement in Hungary's energy transition remains minimal, slowing progress towards climate goals and digital energy adoption. Bottom-up initiatives, civic engagement often stumble on regulatory and market barriers, hampered by an irresponsive sectoral environment. Households cannot have easy access to smart energy and no tariff system has been elaborated for their inclusion yet.

Hungary's energy transition is hindered by a significant gap in human capital, as the current education and training system does not adequately address the skills needed for digital energy technologies and renewable integration. Collaboration between academia and industry is limited, resulting in a lack of practical knowledge transfer and the underutilisation of research for real-world energy solutions.

5.1.4 Technology Adoption & Deployment

Hungary's historic reliance on natural gas has hindered the deployment of renewable energy sources (RES). Data remains underutilised due to limitations in current infrastructure and data sharing, coupled with low penetration of smart meters. Critical information, such as grid bottlenecks, is not shared, reducing the effectiveness of renewable energy integration. In recent years, the focus has been almost exclusively on rolling out solar PVs, while physical network development has lagged due to high costs, unable to keep pace with the rapid expansion of renewable energy production. Additionally, there is an urgent need to increase storage capacities to support this growth. The start of major storage deployment (beyond 1 GWh) is expected only by the Fall of 2025 and driven by the increased threat of a major blackout and/or prohibitive electricity prices in the non-solar peak hours (around 1000 EUR/MWh above 150 hours annually) within the system.

Hungary’s energy infrastructure lags behind EU standards, particularly in the deployment of digital and smart energy technologies. While the rapid growth of residential solar PV installations highlights the potential for renewable energy adoption, the lack of grid capacity and storage solutions undermines its integration, leading to inefficiencies and imbalances. Smart meters and demand-side management systems, which are essential for enabling real-time energy optimisation, are underutilised across the country.

5.1.5 Ecosystem Connectivity

Hungary’s energy innovation ecosystem is concentrated in Budapest and a few other urban centres, leaving rural regions like Northern and Southern Transdanubia with limited access to resources and support for energy transition initiatives. Collaboration between academia, industry, government, and civil society remains fragmented.

The lack of visibility for ongoing projects and successful models further restricts knowledge-sharing and replication of best practices. There is a strong need to enhance cross-sector collaborations involving academia, industry, civil society, and policymakers.

5.1.6 Resilient Growth

Hungary’s energy system faces risks from geopolitical tensions and fluctuating energy supply during high-demand periods, particularly in winter. The lack of investment in storage solutions and a diversified energy mix limits resilience and flexibility. Cybersecurity vulnerabilities, particularly in the energy sector’s digital infrastructure, pose additional risks. Limited data-sharing and visibility among stakeholders impede effective coordination and innovation in energy management.

5.2 Hungary: Actions

The following actions have been identified as critical next steps for Hungary's digital energy transition. These actions were selected based on their alignment with strategic priorities, opportunities for advancing the transition, the level of stakeholder support, and the availability of funding.

Joint Programme vs National Action Plan

The following sections present the actions of the National Action Plan, tailored to country-specific needs, alongside the Joint Action Plan, designed to address shared problems and contribute to a resilient and interconnected European energy ecosystem. The Joint Action Plan addresses shared challenges and overlapping issues faced by participating countries (NL, SK, HU, UA), offering solutions applicable in a broader EU context. It aims to foster collaboration, tackle common barriers, and advance digitalisation, renewable energy adoption, and energy efficiency.

List of Actions prioritised for Hungarian Action Plan

1. Promote dialogue on strategy for energy sector digitalisation
2. Green Energy Knowledge, Operation, and Service Hubs (GEKOS)
3. Support for project design in energy transition and digitalisation
4. University course development about deep-tech in energy transition
5. Awareness raising campaigns for citizen engagement
6. Free Tools for Smarter Consumption- empowering users with accessible, actionable tools to optimise their energy use
7. Facilitating innovative software solutions for EV charging
8. Development and deployment of innovative software solutions for energy community balance settlement
9. Preparatory work on field labs to enhance academia and industry cooperation
10. Dissemination about interoperability experiences across EU
11. Establish a working group, launch and/or strengthen the standardisation dialogue with the necessary actors

List of Actions prioritised for Joint Programme Plan

1. Designing for new energy systems: observability, standardisation and interoperability
2. Designing for new energy systems: Grid usage and management (capacity, aggregation, flexibility & ancillary Services)
3. Facilitating international knowledge exchange for energy sharing groups (communities and hubs)

4. Best Available Technologies (BAT) Open Repository: Curating resources for the digital energy transition.
5. Advancing digital energy innovation education: Tailored training for leadership and workforce development.
6. Strengthening communication and dissemination networks for the digital energy transition
7. Fostering energy innovation ecosystems for the digital energy transition

5.2.1 Promote dialogue on the preparation of a strategy document that aiming at the digitalisation of the energy sector to accelerate the energy transition

Action Title: Promote dialogue on the preparation of a strategy document that aiming at the digitalisation of the energy sector to accelerate the energy transition	**Action #:** HU1 **Action status:** Planning

Action Objective / Description

The objective is to facilitate stakeholder engagement to prepare a strategic document that integrates existing national and European strategies (e.g., NECP, National Energy Strategy, REPowerEU) with the goal of advancing digitalisation in the energy sector. This aims to accelerate the energy transition by incorporating updated visions, specific actions, and cybersecurity considerations.

The energy transition requires significant digital transformation to improve efficiency, resilience, and sustainability in the energy sector. Existing strategies provide valuable foundations but require updates to address emerging challenges and leverage new digital technologies.

The action plan focuses on fostering collaboration and inclusivity through stakeholder engagement and strategic development. Multi-stakeholder workshops will bring together policymakers, energy companies, academia, and digital technology providers to establish a shared understanding of priorities and align with existing strategies like the NECP and REPowerEU. Thematic working groups will tackle key topics, including digitalisation for grid resilience, energy data governance, and cybersecurity frameworks. Public consultations will also play a crucial role, capturing diverse perspectives through surveys and forums to ensure the strategy addresses broad societal needs.

To develop the strategy, existing national and EU policies will be reviewed to identify gaps, and a forward-looking vision with measurable objectives will be crafted. Cybersecurity will be a key pillar, with recommendations covering areas like incident response and supply chain security. Capacity-building efforts will include the creation of a knowledge hub, training workshops, and partnerships with research institutions to drive innovation. A steering committee will oversee the strategy's development, while progress will be monitored using defined metrics, such as digital tool deployment and improvements in cybersecurity resilience.

Action Owner & supporting stakeholders	**Next steps**

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- The coordinating entity is yet to be identified, interested parties being validated.
- The widest possible range of stakeholders, covering all quadruple helix.

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Stakeholder engagement

- Organise an initial multi-stakeholder workshop to identify areas needed for the strategic document.
- Establish thematic working groups focused on digitalisation, data governance, and cybersecurity in the energy sector.

Strategic document development

- Develop a framework aligned with existing national and European strategies.
- Define a future vision and specific objectives, and expand on cybersecurity recommendations in greater detail.

Public consultation and feedback

- Launch a public consultation on the draft strategic document through online platforms and workshops to gather broad feedback.

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Deliverables / outcomes / measures

- A comprehensive strategy document that provides a clear roadmap for digitising the energy sector while ensuring cybersecurity resilience.
- Strengthened collaboration among key stakeholders.
- Enhanced capacity within the domestic energy ecosystem to leverage digital solutions for the energy transition.

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Timeframe

Estimated required timeframe is 18 months

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<td colspan="2">

Policy / Regulatory change required?: [Yes / No]

No adjustments are necessary for the operations of the strategic working group; however, to formalise the shared strategy, corresponding regulatory amendments must be introduced to ensure legal enforceability.

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Existing funding sources

- No existing funding in place

</td>
<td>

Additional budget required

- Full project financing required
- Anticipated total cost: €50,000
- See Appendix 4 for upcoming public funding calls of relevance to HU

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<td>

Problem # mapping

Policy and Regulations: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

</td>
<td>

Recommendations # mapping

Policy and Regulations: 1.2, 1.3

</td>
</tr>
</table>

	Human Capital: 3.4

5.2.2 Further support to leverage Green Energy Knowledge, Operation, and Service Hubs (GEKOS)

Action Title: Further support to leverage Green Energy Knowledge, Operation, and Service Hubs (GEKOS)	**Action #:** HU2
	Action status: Ongoing – Continuation contingent on funding

Action Objective / Description

This action builds on the ongoing Interreg SMEnergy project, which supports the design and definition of service hubs across the Danube region, enriched by international knowledge exchange. Through stakeholder research, services and solutions are defined based on needs and best practices of energy-intensive industrial players. Activities include awareness campaigns, capacity-building workshops, the operation and expansion of an online Green Energy Database and Market place, automated online pre-audit tool, tailor made consulting support, and policy advocacy to drive adoption and national integration. Within the scope of the project the service model will be piloted, establishing a foundation for full-scale implementation in Hungary.

Green Energy Knowledge, Operation, and Service Hubs (GEKOS) provide assistance, expert consultation, and support to find investments to aid energy-intensive SMEs in optimizing energy consumption, enhancing energy efficiency, and facilitating renewable energy investments.

The concept is that energy-intensive SMEs can rely on GEKOS as a one-stop service hub, providing all the necessary resources to support energy optimization, efficiency improvements, and renewable investments. Through this single service point, SMEs gain access to the tools and support needed starting from energy audit, expert consultation, project preparation, support to find investment and project implementation. These hubs will contribute to the seamless energy transition, building on the service framework defined by SMEnergy and with WEnnovate we can bring an increased focus on integrating digital solutions and real-time energy management capabilities with additional support on consulting activities on cutting-edge energy management software, IoT-enabled energy monitoring, and innovative optimisation tools available in the market.

WEnnovate intends to further support the implementation and the operation of GEKOS by providing additional financial resources to increase its scale, reach, and the integration of deep-tech innovations.

The action "**Further Support to Leverage GEKOS**" focuses on implementing and expanding the HUB in Hungary by actively engaging energy-intensive SMEs through targeted outreach and awareness

campaigns. These campaigns will emphasize the benefits of GEKOS hubs, such as cost savings, enhanced energy efficiency, and access to advanced digital tools.

The hubs will offer access to a comprehensive **Green Energy Database and Marketplace**, featuring recommended tools, a knowledge repository, trusted vendors, and an **automated online pre-audit tool**. Tailored consulting support will also be provided, based on initial pre-energy audits, to address the specific needs of each SME. Furthermore, customers will receive guidance in identifying and accessing financing options, such as grants and loans, to facilitate energy optimization and the adoption of sustainable solutions.

The action also includes iterative service improvements, driven by feedback from users, ensuring the continuous refinement of the HUB's offerings. Advocacy efforts are integrated to secure additional resources, supporting the HUB's scalability and long-term sustainability.

Phase 1: Launch Tailored GEKOS Services (M1-M4)
Begin operations by conducting energy audits, offering expert consultations, integrating digital tools, and providing financing support to help SMEs optimise energy use and implement renewable energy projects.

Phase 2: Execute Targeted Outreach and Stakeholder Engagement (M5-M8)
Engage SMEs and other stakeholders through outreach campaigns, workshops, and demonstrations to showcase the benefits of GEKOS, building awareness and a strong customer base.

Phase 3: Iterative Service Improvement -Scale-up (M9-M14)
Continuously refine GEKOS services by collecting feedback from SMEs, evaluating service performance, and incorporating advanced tools and best practices to address emerging challenges.

Phase 4: Advocacy and Resource Allocation (M15-24)
Advocate for additional financial resources and support programs to expand GEKOS's scale and reach while ensuring its long-term sustainability and impact.

Action Owner & supporting stakeholders	**Next steps**
• Energiaklub as a participant in the SMEnergy project within 8 countries and 18 partner institutions • AI EDIH supporting the digital service stream • The National Research, Development and Innovation Office supports the project with advisory on national and EU level funding opportunities for municipalities.	• Update on the GEKOS service portfolio by including the digital innovation support, • Strategy for communication outreach activities and based on it targeted outreach campaign • Collect and analyse SME feedback to refine services • Secure funding and policy support to further scale GEKOS
Deliverables / outcomes / measures	**Timeframe** M1-M3 Preparation and launch M5-M8 Outreach

<table>
<tr><td>

- Digital solution integration plan: Design and implementation of a strategy to integrate advanced digital tools into GEKOS offerings
- GEKOS framework roll-out plan
- Updated knowledge repository of GEKOS
- Communication and outreach plan
- Iterative service improvement report

</td><td>M9-M14 Iterative Service Improvement
M15-M24 Advocacy and resource allocation

Estimated time frame 24 months</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: [Yes / No]
No change required</td></tr>
<tr><td>

Existing funding sources

- Existing project is running with a support of Interreg

</td><td>

Additional budget required

- Full project financing required
- Anticipated total cost: €150,000-€200,000
- See Appendix 4 for upcoming public funding calls of relevance to HU

</td></tr>
<tr><td>Problem # mapping
Market State and Funding: 13, 14, 16, 17, 18, 21, 22, 30</td><td>Recommendations # mapping
Technology Adoption and Deployment: 4.3</td></tr>
</table>

5.2.3 Support for project design and development in energy transition and digitalization for municipalities and local initiatives

Action Title: Support for project design and development in energy transition and digitalization for municipalities and local initiatives	**Action #:** HU3
	Action status: Planning

Action Objective / Description

Local initiatives and municipalities in Hungary face significant pressure to efficiently manage their often substantial energy consumption. However, they frequently lack the necessary assistance, funding, and in-house energy expertise to independently implement digital energy sector solutions. Some of them are eager to engage in projects and facilitate positive change, but selecting the most appropriate and cost-efficient technology combinations and securing funds for it remains a challenge.

By increasing support and funding at the local level can develop viable adaptation strategies, business models, and incentives. Involving municipalities in the implementation phase will provide practical experience, enhance efficiency, and promote sustainable energy practices as they are in contact with the public and are responsible for the maintenance of many and various types of property.

WEnnovate intends to support the identification of projects in the field of energy transition and digitalization that support the ambitions of these underfunded actors, and to provide technical support to create an efficient and sustainable implementation of these projects through grant funding.

In the first step, an awareness raising and basic skills workshop will take place in the framework of a 2-day retreat, with 2-2 participants per municipality, to support each other in innovative solutions when they return home. In the second step, peer to peer learning teams will be formed with different municipalities, in which projects of exemplary municipalities will be actively followed by the following municipalities throughout the design and implementation of the project.

Phase 1: Partner identification and preparation (M1-M6)
The project begins with identifying and engaging municipalities and other relevant partners committed to energy transition and digitalisation. This phase also involves conducting comprehensive data collection and needs assessments, including evaluating current energy usage, exploring the feasibility

of decentralised energy solutions, and identifying critical issues such as local energy poverty. These foundational activities will set the stage for designing targeted and effective interventions.
In M1–M3 the main focus is on identifying and engaging municipalities and other project partners. In M4–M6, conducting data collection and needs assessment.

Phase 2: Capacity building and project development (M7–M12)
A key step in the project is to build awareness and foundational skills through a 2-day workshop (M7), ensuring that municipalities and their representatives are equipped to participate effectively. Following this, peer-to-peer learning teams will be formed to facilitate knowledge sharing and collaboration among stakeholders. This phase also focuses on developing project concepts, identifying potential funding sources, and preparing grant applications to secure resources for implementation. These activities aim to foster a collaborative environment that promotes innovation and practical project development.

Phase 3: Funding and implementation (M13–M24)
The project transitions to finalising detailed project designs and submitting funding applications to relevant EU, national, or international programmes. Advocacy efforts will also focus on establishing new funding mechanisms to address identified gaps. Once funding is secured, the project will implement practical and sustainable solutions tailored to the needs of participating municipalities. Throughout this phase, peer-to-peer learning and progress monitoring will ensure that projects are executed effectively and deliver meaningful results.

Ongoing activities throughout the project (M1-M24)
Throughout the project, ongoing efforts will include awareness-raising campaigns to keep stakeholders engaged, technical support to address challenges, and continuous advocacy for the creation of additional funding opportunities. These activities will ensure the scalability of the project and its long-term impact, enabling municipalities and partners to sustain their energy transition initiatives.

Action Owner & supporting stakeholders	**Next steps**
• The coordinating entity is yet to be identified, interested parties being validated. • Energiaklub has extensive contacts with local authorities, experience in supporting them in preparing projects and expertise in energy transition initiatives. • The National Research, Development and Innovation Office supports the project with advisory on national and EU level funding opportunities for municipalities.	• Evaluate current energy use and identify areas for improvement (including management of municipality building portfolio, addressing and engaging residence, accessing and addressing issues of local energy poverty, feasibility of decentralized energy solution, digital solutions.). • Design and develop projects: finding sources of funding, creating a project concept, writing a tender, channeling professional expertise on energy – in the process ensure broad participation, and

<table>
<tr><td></td><td>foster practical solutions in energy transition and digitalization.
● Advocate setting up funding programs with grants, subsidies, and low-interest loans or facilitate access to EU and international funds.</td></tr>
<tr><td>Deliverables / outcomes / measures

● Awareness raising and basic skills workshop - 2-day retreat
● Creating local teams, peer to peer learning throughout the design and implementation of the project
● Project design documentation is implemented</td><td>Timeframe

M1–M3: Identify and engage municipalities and other project partners
M4–M6: Conduct data collection and needs assessment
M7: Organise a 2-day workshop
M8–M12: Form peer-to-peer learning teams to facilitate knowledge sharing and collaboration. Start designing project concepts, identifying funding sources, and preparing grant applications.
M13–M24: Finalising project designs and submit funding applications

Estimated timeframe 24 months</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: [Yes / <u>No</u>]
No change required</td></tr>
<tr><td>Existing funding sources
● No existing funding in place
● Under-funded municipalities and under-investment in energy efficiency in local initiatives require immediate action</td><td>Additional budget required
● Full project financing required
● Anticipated total cost: €75,000-€100,000
● See Appendix 4 for upcoming public funding calls of relevance to HU
● Fund for a 2-day workshop
● Fund for 2 years the participation of an expert to design projects in the field of energy transition and digitalization</td></tr>
<tr><td>Problem # mapping
Policy and Regulations: 11, 12</td><td>Recommendations # mapping
Policy and Regulations:1.8, 1.9, 1.10, 1.11, 1.12, 1.13
Technology Adoption and Deployment: 4.1</td></tr>
</table>

5.2.4 University course development about deep-tech in energy transition

Action Title: University course development about deep-tech in energy transition	**Action #:** HU4
	Action status: Planning

Action Objective / Description

This action involves creating a digital, on-demand e-course focused on deep-tech innovations critical to the energy transition. The course will be designed as an elective course at universities across Hungary, allowing institutions to integrate it into existing curricula. Delivered through high-quality video modules and written online course material, the e-course will cover essential topics on digitalisation of the energy sector. The curriculum explores cutting-edge digital and deep-tech solutions driving the energy transition, including smart energy systems, decentralised trading, advanced storage, and grid resilience. Through an interdisciplinary approach, students gain practical insights into the technologies and innovations shaping a sustainable, digitalised energy future.

The proposed freely elected e-course offers a unique opportunity to enhance the academic curriculum at BSc, MSc, and PhD levels, particularly within faculties focused on electrical engineering and related disciplines. Designed to address the growing skill gap in digital energy technologies, this e-course provides accessible, high-quality learning materials that prepare students for critical roles in driving the energy transition.

The course features interactive assessments, a grading survey, and a feedback loop for continuous improvement, making it a scalable and adaptive learning tool. By integrating these advanced pedagogical elements, the e-course ensures students gain practical, cutting-edge knowledge and skills while fostering active engagement.

This initiative aligns with global trends in education and industry by equipping students with expertise in digital energy systems, renewable energy integration, and deep-tech applications. It also supports interdisciplinary learning, fostering innovation readiness and preparing students for leadership roles in shaping a sustainable and technologically advanced energy future.

Indicative universities and faculties identified as potential partners include:

- Budapest University of Technology and Economics (BME)
    - Faculty of Electrical Engineering and Informatics (VIK)
        - BSc in Electrical Engineering
        - MSc in Electrical Engineering
        - PhD in Electrical Engineering
- Óbuda University (ÓE)
    - Kandó Kálmán Faculty of Electrical Engineering (KVK)
        - BSc in Electrical Engineering
        - MSc in Electrical Engineering

<table>
<tr><td colspan="2">

PhD in Electrical Engineering

Óbuda University Alba Regia Technical Faculty (ÓE AMK)

BSc in Electrical Engineering

Széchenyi István University (SZE)

Faculty of Mechanical, Informatics and Electrical Engineering (GIVK)

BSc in Electrical Engineering
MSc in Electrical Engineering

University of Pannonia (PE)

Faculty of Information Technology (MIK)

BSc in Electrical Engineering
MSc in Electrical Engineering

University of Debrecen (DE)

Faculty of Science and Technology (TTK)

BSc in Electrical Engineering
MSc in Electrical Engineering

University of Pécs (PTE)

Faculty of Engineering and Information Technology (MIK)

BSc in Electrical Engineering
MSc in Electrical Engineering

University of Miskolc (ME)

Faculty of Mechanical Engineering and Informatics (GÉIK)

BSc in Electrical Engineering
MSc in Electrical Engineering

</td></tr>
<tr><td>Action Owner & supporting stakeholders
Coordinating entity is Design Terminal, interested parties being validated e.g. partner universities, industry experts.</td><td>Next steps
Reach out to universities and seek endorsement to ensure the course’s relevance to their energy-related curricula.
Develop a comprehensive syllabus with video lectures and written online course material, digital resources, and interactive assessments to test understanding.
Pilot and feedback collection: Launch a pilot version of the course, collect feedback from students and faculty, and refine based on responses.</td></tr>
<tr><td>Deliverables / outcomes / measures
A fully digital, video-based with written online course material e-course on deep-tech in energy transition, with interactive grading and feedback mechanisms to support student engagement and learning assessment.</td><td>Timeframe
M1-M4: Course outline and initial university partnerships established.
M5-M8: Syllabus development, video production, and funding secured.
M8-M12: Pilot phase, first enrolment, and initial feedback analysis.

Estimated timeframe: 12 months</td></tr>
</table>

<table>
<tr><td colspan="2">Policy / Regulatory change required?: [Yes / No]
No change required</td></tr>
<tr><td>Existing funding sources
No existing funding in place</td><td>Additional budget required
Full project financing required
Anticipated total cost: €90,000-€120,000
See Appendix 4 for upcoming public funding calls of relevance to HU</td></tr>
<tr><td>Problem # mapping
Human Capital: 31, 37, 38, 39, 40, 41, 42, 43, 44</td><td>Recommendations # mapping
Market state and funding: 2.6
Human Capital: 3.3</td></tr>
</table>

5.2.5 Awareness raising campaigns for citizen engagement

Action Title: Awareness raising campaigns for citizen engagement	**Action #:** HU5
	Action status: Planning

Action Objective / Description

This action involves launching a series of educational campaigns to inform the public about the critical importance of energy transition, flexibility in energy usage, and the role of digitalisation in addressing climate change. The aim is to build awareness and foster community engagement, empowering citizens to understand and adopt practices that contribute to a sustainable energy future.

The campaigns will address the current lack of public understanding about energy systems, focusing on how individual actions can collectively make a significant impact on decarbonisation efforts. By showcasing relatable examples, the initiative will bridge the gap between advanced energy solutions and everyday life, making sustainable practices more accessible to all.

Campaigns will highlight how digital innovations, such as smart energy management and flexible consumption, support a resilient energy system. For instance, they will showcase how smart devices, like energy management apps or programmable thermostats, can optimise energy use, lower bills, and reduce carbon footprints. Real-world case studies will demonstrate how aligning energy consumption with renewable production periods (e.g., using electricity during sunny hours) leads to both personal and environmental benefits.

Through digital platforms, interactive content, and community events, the campaign will demonstrate the practical steps citizens can take to actively participate in and benefit from the energy transition. Digital tools will include engaging infographics, educational videos, and gamified applications that motivate citizens to adopt sustainable energy habits. Community workshops and local forums will provide spaces for citizens to learn, discuss, and collaborate on solutions tailored to their specific energy contexts.

In addition, the campaign will emphasise the role of collective action, encouraging the formation of local energy groups or cooperatives. By empowering citizens with knowledge and tools, this initiative will build a foundation for lasting behavioral change and strengthen public support for energy transition policies.

<table>
<tr>
<td>Action Owner & supporting stakeholders
● The coordinating entity is Design Terminal, interested parties being validated e.g. local authorities, environmental NGOs, educational institutions, community leaders, media outlets.</td>
<td>Next steps
● Create engaging digital materials (videos, infographics, social media content) that explain key concepts in energy transition, flexibility in energy usage, and the role of digital solutions in climate action.
● Partner with local authorities, educational institutions, and environmental organisations to co-create content and amplify the campaign's reach.
● Roll out the campaign through social media, local events, and public forums, focusing on digital literacy around energy transition topics and how individuals can adopt flexible, efficient energy practices.</td>
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<tr>
<td>Deliverables / outcomes / measures
● Educational materials: A comprehensive set of engaging content (videos, infographics, social media posts) explaining energy transition and the role of digitalisation.
● Community events formats and methodologies: A series of interactive events, including workshops, forums and serious games.
● Digital campaign execution: Implementation of a multi-platform social media campaign to raise awareness and encourage individual action.</td>
<td>Timeframe

M1–M3 Preparation
● Develop digital materials, including videos, infographics, and social media content.
● Develop a communication strategy of the campaign

M4-M6 Campaign rollout
● Launch the campaign across digital platforms and local media channels.
● Organise community events and interactive sessions to engage citizens directly.

M7-M9 Engagement and feedback
● Monitor citizen engagement and gather feedback to refine messaging and outreach strategies.
● Conduct follow-up activities, such as webinars or additional events, to sustain momentum.

Estimated timeframe: 9 months</td>
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<tr>
<td colspan="2">Policy / Regulatory change required?: [Yes / <u>No</u>]
No change required</td>
</tr>
<tr>
<td>Existing funding sources
● No existing funding in place</td>
<td>Additional budget required
● Full project financing required
● Anticipated total cost: €60,000-€100,000
● See Appendix 4 for upcoming public funding calls of relevance to HU</td>
</tr>
</table>

Problem # mapping	**Recommendations # mapping**
Human Capital: 31, 32, 33, 34, 35, 36, 38	Human Capital: 3.5, 3.6, 3.7, 3.8

5.2.6 Free Tools for Smarter Consumption- empowering users with accessible, actionable tools to optimise their energy use

Action Title: Free Tools for Smarter Consumption- empowering users with accessible, actionable tools to optimise their energy use	**Action #:** HU6
	Action status: Planning

Action Objective / Description

This action targets the development, launch, and facilitation of a platform offering software-supported solutions (applications) to help end-users optimise their energy consumption, with free access to maximise societal impact. These applications aim to empower users by providing actionable insights, tailored recommendations, and interactive features to encourage smarter energy usage for their own financial benefit and to support climate and energy transition goals.

Key components include:

1. **Electric Vehicle (EV) Optimisation App**: Sends push notifications to encourage charging during low-carbon energy production periods (e.g., sunny hours for solar panel users) and promotes optimal battery practices (e.g., avoiding full depletion and charging to 80% for battery longevity). The app can actively communicate with EVs where integration is supported.
2. **Smart Home App**:
    - Incentivises users to align energy consumption with periods of low-carbon production, showcasing financial and environmental benefits through user-friendly visuals and real-time insights. The app would show the carbon footprint of electricity in 15-minute intervals, indicating whether there is a surplus or shortage of power. If appliances can be scheduled, they should be connectable to the software for automatic on/off switching via Wi-Fi at home.
    - Provides tailored tips to improve energy efficiency using low-tech or tech solutions, such as adjusting appliance usage, improving home insulation, or integrating smart home devices.
    - Acts as a behavioural change tool by educating users on the benefits of flexible energy usage and fostering a better understanding of how their actions contribute to cost savings and environmental impact.

The platform will also be designed to accommodate the addition of similar tools in the future, enabling ongoing expansion of the software suite. This flexible toolset will evolve to include new applications as technology and user needs develop, further enhancing the platform's value and impact. The key

objective is to ensure the applications are accessible to all users at no cost, fostering widespread adoption and enabling users to take actionable steps for their own energy and climate benefits.

The project will also include a communication campaign to maximise user engagement and adoption, highlighting the environmental and cost-saving advantages of these free tools.

Phase 1: Planning and Requirement Gathering (M1–M2)
During this phase, detailed functionalities for the EV Optimisation App and Household Energy Optimisation App will be defined based on consultations with stakeholders and potential end-users. User requirements will be gathered to ensure the applications address practical needs effectively. Technical specifications and user interface designs will also be outlined, providing a clear framework for the development process.

Phase 2: Development and Testing (M3–M6)
The development phase will focus on creating prototypes for both applications. The EV Optimisation App will feature functionalities like low-carbon charging notifications and battery management recommendations, while the Household Energy Optimisation App will include energy-saving tips and real-time insights. Usability testing will be conducted with focus groups to gather feedback, identify improvements, and resolve technical issues. This iterative process will ensure the apps are user-friendly and meet their intended objectives.

Phase 3: Deployment, Promotion, and Future Planning (M7–M12)
The finalised apps will be deployed on digital platforms, supported by a comprehensive communication campaign to promote adoption. Marketing materials, such as social media posts and user guides, will be prepared to reach target audiences, including energy-conscious consumers, EV owners, and households. Partnerships with NGOs and energy providers will enhance outreach efforts. During the final months, app performance will be monitored, and user feedback will guide the planning of future expansions, incorporating emerging technologies and addressing evolving user needs.

Action Owner & supporting stakeholders	**Next steps**
• Coordinating entity is yet to be identified, interested parties being validated e.g. energy and climate advocating NGOs, energy providers, vehicle manufacturers, smart device developers	• Application design and development. • Partner with energy providers, vehicle manufacturers, smart device developers. • Conduct pilot tests to refine features and ensure seamless integration with different devices. • Launch a campaign to educate end-users about the benefits of the free platform and applications, using digital marketing, social media, and partnerships with energy stakeholders.
Deliverables / outcomes / measures	**Timeframe**
• Two core applications: one for EV charging optimisation and one for household energy usage, with integrated energy-saving tips and behavioural change tools.	M1–M2: Requirement gathering and initial planning M3–M6: Development and testing phase M7-M12: Launch and communication campaign preparation

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- A communication campaign driving widespread adoption of the free tools.

</td><td>M9–M18: Post-release monitoring and incremental updates (bug-fixes)
M15–M18: Monitoring and expansion planning

Estimated timeframe: 18 months</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: [Yes / No]
No change required</td></tr>
<tr><td>Existing funding sources

- No existing funding in place

</td><td>Additional budget required

- Full project financing required
- Anticipated total cost: €150,000-€200,000
- See Appendix 4 for upcoming public funding calls of relevance to HU

</td></tr>
<tr><td>Problem # mapping
Human capital: 31, 32, 33, 34, 35, 36
Technology Adoption and Deployment: 49, 50, 51, 52, 53, 54, 55, 56, 57</td><td>Recommendations # mapping
Human capital: 3.1, 3.5, 3.6, 3.7
Technology Adoption and Deployment: 4.3, 4.4, 4.6, 4.7, 4.8</td></tr>
</table>

5.2.7 EnerGridChain

Action Title: EnerGridChain	**Action #:** HU7
	Action status: Prepaired to be implemented

Action Objective / Description

Developing user-friendly, scalable software solutions for energy optimisation in collaboration with public institutions, universities and technology partners. To support this, a platform will be created to connect the different actors, and to lay the foundations for their future cooperation.

For a blockchain-based solution for EV charging, a pilot is to be implemented to provide a clear view of the aspects that underpin the basis and operation of such a system. In addition to addressing technological challenges, the project will establish a Compliance Sandbox framework in collaboration with regulatory authorities. This sandbox will provide a controlled environment where energy communities, municipalities, and technology partners can test platform functionalities, including balance settlement management, data-sharing protocols, and EV charging integration. The sandbox approach fosters safe experimentation and learning by allowing participants to pilot innovative features in real-world conditions without the risk of regulatory penalties. Insights gathered from this process will guide regulatory adaptation, ensuring alignment with emerging technologies and market needs.

The solution will allow owners of household-scale solar power plants to access the electricity generated by their own system in geographically dispersed locations, while paying only the cost of transporting the energy, i.e. actually using the electricity infrastructure. With this combination, the system therefore encourages consumers to invest in solar panels and use their electric cars even if they are not actually using the electricity they generate themselves. The pilot aims to conduct a test operation involving 1,000 vehicles, forming the basis for a comprehensive evaluation of the system's technological, regulatory, and operational aspects.

The pilot will help to ensure that, in line with the energy transition goals, electrification in transport also means that the electricity used is renewable rather than fossil, so that not only urban air quality is improved, but emissions are also substantially reduced. The pilot will also model the stakeholder collaboration needed to integrate elements that influence consumption patterns into the system to support the uptake of renewable energy.

The Blockchain Coalition has reviewed and approved a comprehensive "white paper" on this concept, authored by a Gyula Solymos who holds the intellectual property rights. Accompanied by a high-level technological blueprint, a detailed project budget, and an implementation plan, this document establishes a solid foundation for the action.

Action Owner & supporting stakeholders	**Next steps**

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- Alpha Management Advisory (Industry), as coordinating entity
- The action incorporates a know-how "white paper" developed by a private individual Gyula Solymos, approved by the BlockChain Coalition presidency, with the individual holding the copyright.
- BlockChain Coalition (Industry), Energy Working Group
- Neumann Nonprofit Kft (Governmental)
- Further interested parties are being validated.

</td>
<td>

- Establish partnerships with public institutions, universities, and technology providers to collaborate on software development.
- Create a platform to connect stakeholders and facilitate communication and resource sharing.
- Conduct a feasibility study and develop a blockchain-based pilot for efficient electric car charging.
- Analyse the regulatory environment to ensure compliance and identify necessary adjustments.
- Engage with the target audience to demonstrate the system's operational benefits and gather feedback.

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Deliverables / outcomes / measures

- A scalable, user-friendly platform that connects key actors in energy optimisation and charging solutions.
- A pilot project demonstrating blockchain-based electric car charging, including technical documentation and performance metrics.
- A regulatory assessment report outlining key considerations and compliance recommendations.

</td>
<td>

Timeframe

Phase 1: Preparation (M1–M6)
M1–M6: Software development (platform architecture and initial blockchain pilot framework)

Phase 2: Pilot implementation (M7–M12)
M7–M9: Launch the platform and implement the blockchain-based pilot.
M10–M12: Monitor pilot performance, comprehensive evaluation of the system's technological, regulatory, and operational aspects.

Estimated timeframe: 12 months

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<td colspan="2">

Policy / Regulatory change required?: [Yes / No]
No change required

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<td>

Existing funding sources

- Securing additional funding is currently under active consideration, though it remains pending confirmation at this stage.

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Additional budget required

- Full project financing required
- Anticipated total cost: **€920,000** to cover technology development and testing
- A larger public pilot involving 1,000 vehicles over 12 months is projected to cost approximately €900,000. This includes around €400,000 for six months of software development, with the remainder allocated to hardware procurement, testing, feedback collection, and analysis.
- See Appendix 4 for upcoming public funding calls of relevance to HU

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Problem # mapping

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<td>

Recommendations # mapping

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</tr>
</table>

Technology Adoption and Deployment: 49, 50, 51, 52, 53, 54, 55, 56, 57	Technology Adoption and Deployment: 4.3, 4.4, 4.6, 4.7, 4.8

5.2.8 Development and deployment of innovative software solutions for energy community balance settlement

Action Title: Development and deployment of innovative software solutions for energy community balance settlement	**Action #:** HU8
	Action status: Planning

Action Objective / Description

This action focuses on developing an accessible and robust software platform designed to support energy communities and cooperatives in managing balance settlements effectively. Energy communities often face considerable challenges, including the lack of a viable business model, regulatory barriers, and limited resources. While these constraints are significant, gradual progress in regulation and market incentives may create new opportunities. In preparation for these shifts, energy communities need user-friendly, cost-effective software solutions that support their operations without requiring heavy investments. Such tools must address critical challenges, including maintaining a credible balance settlement ledger to ensure transparent and reliable operations. The software will be provided either for free or at a very affordable cost, depending on project funding and development and periodic future software update expenses.

In addition to these capabilities, the platform will aim to support the local storage and utilization of locally produced energy. This feature could contribute to the development of more resilient communities and energy systems. Furthermore, it may help achieve environmental objectives, as a community energy storage system can be up to five times more efficient than individual household battery systems. Community storage requires significantly fewer rare earth metals compared to multiple smaller units, reducing material demand. Additionally, the production of a single large storage unit results in a lower carbon footprint compared to manufacturing numerous smaller systems, emphasizing the platform's sustainability impact.

To support development, the project will establish a compliance sandbox in collaboration with regulatory authorities. This framework will provide a controlled environment for energy communities, municipalities, and technology partners to test platform functionalities, such as balance settlement and community energy storage, in real-world conditions. The sandbox fosters innovation by enabling experimentation without regulatory penalties while offering policymakers insights to adapt frameworks

for emerging technologies. By including urban and rural energy community models, the project addresses diverse needs and promotes collaboration with solar-focused companies and municipalities exploring ESCO-aligned business models.

The proposed platform will leverage advanced technologies like blockchain or other secure and efficient solutions to streamline administrative processes and enhance data management. By providing secure, transparent, and automated features, the platform will reduce the operational burden for energy community operators. Key functionalities will include for example transaction recording, automated balance calculations, and data immutability, fostering trust and accountability among participants. Additionally, the platform will facilitate the active involvement of distributed energy system operators (DSOs) and energy traders in the ledger, enabling seamless integration with community-level energy data and supporting the broader adoption of decentralised energy solutions. This comprehensive approach will empower energy communities to operate more efficiently and adapt to an evolving regulatory and market landscape.

Phase 1: Stakeholder Engagement and Requirement Gathering (M1-M3)
The first phase focuses on building a strong foundation for the project by engaging key stakeholders. A working group will be formed, including representatives from energy communities, Distributed System Operators (DSOs), and technology partners, to ensure diverse perspectives and expertise. Workshops will be conducted to gather insights into user requirements, operational challenges, and regulatory frameworks. These discussions will help shape the platform's features, ensuring alignment with stakeholder needs and compliance with current and anticipated regulations.

In addition, the project aims to incorporate urban and rural energy community models into the pilot testing phase. This dual approach will enable the platform to address the unique challenges and opportunities faced by both types of communities, enhancing its applicability and scalability. Several energy communities have already expressed serious interest in participating, contingent on project initiation. Moreover, multiple municipalities and a solar-focused company are prepared to engage, provided there is a supportive regulatory environment and a viable solution that could underpin their business models, potentially operating in an ESCO (Energy Service Company) framework.

Phase 2: Platform Development and Pilot Implementation (M4-M9)
This phase centres on the technical development and initial deployment of the software. A prototype will be developed using blockchain or alternative technologies to ensure secure, transparent, and efficient data management. Core features, such as transaction logging and automated balance calculations, will be tested to validate their functionality. The software will then be deployed in selected energy communities as part of a pilot implementation. Feedback from users will be gathered to identify usability challenges and technical issues, which will be addressed to optimise the platform’s performance and user experience.

Phase 3: Scalability Planning and Full-Scale Deployment (M10-M12)
The final phase focuses on refining the software and planning for broader adoption. Based on feedback and results from the pilot phase, the platform will be enhanced to meet user needs more effectively. A detailed roadmap will be prepared for scaling the platform to additional energy communities, outlining necessary steps for deployment and identifying potential funding opportunities. Partnerships with

<table>
<tr><td colspan="2">stakeholders and strategies for ongoing maintenance and updates will be developed to ensure the platform's sustainability and long-term impact.</td></tr>
<tr><td>Action Owner & supporting stakeholders
Coordinating entity is yet to be identified,
BlockChain Coalition (Industry) Energy Working Group,
Transformator is the community energy incubator of the Solidarity Economy Center (SEC) (NGO),
Alpha Management Advisory (Industry)</td><td>Next steps
Form a working group with energy communities, DSOs, and technology partners to define project requirements.
Conduct workshops to gather user needs and align platform features with regulatory frameworks.
Develop and test a prototype with core functionalities like transaction logging and balance automation.
Deploy the software in pilot communities, gather feedback, and address usability issues.</td></tr>
<tr><td>Deliverables / outcomes / measures
Requirement analysis report: Detailing community needs and regulatory constraints.
Software platform prototype: Functional platform with features like balance settlement, automated calculations, and secure data management.
Pilot report: Insights and feedback from initial deployment in selected energy communities.
Scalability plan: Strategy for broader deployment across energy communities.</td><td>Timeframe
M1–M3: Stakeholder engagement and requirement gathering.
M4–M7: Software design and development, including initial testing.
M8–M9: Pilot implementation and feedback collection.
M10–M12: Refinement of the software platform and scalability analysis.</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: [Yes / No]
Yes, regulatory change is required to provide detailed implementation rules for energy communities that enable them to operate properly.</td></tr>
<tr><td>Existing funding sources
Securing additional funding is currently under active consideration, though it remains pending confirmation at this stage.</td><td>Additional budget required
Full project financing required
Anticipated total cost: €800,000-€950,000
See Appendix 4 for upcoming public funding calls of relevance to HU</td></tr>
<tr><td>Problem # mapping
Technology Adoption and Deployment: 52, 53, 54, 55, 56, 57, 61, 62, 63, 68
Resilient Growth: 91</td><td>Recommendations # mapping
Market state and funding: 2.1, 2.2, 2.3, 2.4
Technology Adoption and Deployment: 4.1, 4.3, 4.5, 4.6, 4.7, 4.8</td></tr>
</table>

5.2.9 Preparatory work on field labs to enhance academia and industry cooperation

Action Title: Preparatory work on field labs to enhance academia and industry cooperation	**Action #:** HU9
	Action status: Planning

Action Objective / Description

This action aims to establish the groundwork for field labs that foster collaboration between universities and industry, promoting digital deep-tech innovations that support energy transition goals. Inspired by successful models like the Delft Living Lab, these field labs will act as pilot innovation centres where academic research meets practical, real-world applications.

Initial steps involve identifying and engaging key stakeholders, forming a dedicated working group, and drafting project plans that outline objectives, resources, and responsibilities. The goal is to create a sustainable environment for ongoing innovation, providing a platform for testing and scaling digital solutions in energy management and sustainability.

Currently, Hungary does not have dedicated field labs that serve as collaborative hubs for academia and industry in the context of energy transition and digital deep-tech innovation. The absence of such platforms limits the ability of universities and companies to co-develop, test, and scale real-world solutions. Moreover, this gap results in missed opportunities for knowledge exchange, reduced capacity for practical skills development, and slower adoption of cutting-edge technologies in energy management.

Expected Benefits

The establishment of field labs is expected to deliver significant benefits, including:

- **Innovation acceleration:** By providing a structured environment for academia and industry to work together, field labs will accelerate the development and adoption of innovative energy solutions.
- **Skills development:** Students and researchers will gain hands-on experience with advanced technologies, improving their employability and readiness for energy-focused careers.
- **Enhanced collaboration:** Strengthened ties between universities and companies will lead to better alignment between research outputs and industry needs.
- **Energy transition support:** Practical solutions tested in the field labs will contribute to Hungary's energy transition goals by advancing smart energy systems, decentralised trading, and sustainable energy practices.

- **Economic impact:** Successful innovations can attract investment, foster startup ecosystems, and improve the competitiveness of local industries.

Potential Applications

The field labs will support a variety of use cases, such as:

- **Testing new technologies:** Pilot smart energy grids, advanced storage solutions, and AI-driven energy management systems.
- **Prototyping and validation**: Validate early-stage solutions for energy efficiency and renewable energy integration.
- **Training and upskilling:** Provide training facilities for students, researchers, and professionals on cutting-edge tools and technologies.
- **Policy simulation:** Offer a controlled environment to test policy scenarios and their impact on energy systems.
- **Community engagement:** Use the labs to educate communities and demonstrate the benefits of energy innovations.

Preparatory Outcomes

By the end of the preparatory phase, the project aims to:

- Define the technical and operational requirements for the first field lab.
- Secure commitments from key stakeholders, including potential financial contributors.
- Produce a comprehensive project proposal that outlines clear steps for establishing and running the field lab.

These steps will position the project to transition smoothly from planning to implementation, setting the stage for Hungary's first field labs dedicated to fostering innovation in energy transition and sustainability.

Action Owner & supporting stakeholders	**Next steps**
• The coordinating entity is yet to be identified, interested parties being validated.	• **Stakeholder engagement**: Expand outreach to relevant stakeholders, including academic institutions, energy companies, policymakers, and technology providers. • **Feasibility study**: Assess operational and technological needs, identifying potential gaps and risks. • **Working group formation**: Establish a multidisciplinary team to drive the planning process. • **Drafting project plans**: Develop detailed documentation outlining timelines, objectives, resources, and governance structures. • **Securing initial funding**: Apply for grants or private sector funding to ensure resource availability for setup and operations.

<table>
<tr><td></td><td>

- **Location scouting**: Identify a pilot site that aligns with accessibility, infrastructure, and collaboration goals.

</td></tr>
<tr><td>

Deliverables / outcomes / measures

Technical requirements and feasibility report: Specifications for infrastructure and equipment, along with a site analysis evaluating accessibility, infrastructure needs, and feasibility for energy-focused projects.

Final project preparatory document: Detailed project objectives, scope, phases, roles, and responsibilities, with a budget covering setup, operations, and funding sources.

</td><td>

Timeframe
M1-M2: Stakeholder Alignment and Working Group Formation

M3-M4: Technical Requirements and Feasibility Report

M5: Draft Project Preparatory Document

M6: Final Project Preparatory Document

Estimated timeframe: 6 months

</td></tr>
<tr><td colspan="2">

Policy / Regulatory change required?: [Yes / No]
No change required related to project preparatory phase.

</td></tr>
<tr><td>

Existing funding sources

- No existing funding in place

</td><td>

Additional budget required

- Full project financing required
- Anticipated total cost: **€50,000**
- See Appendix 4 for upcoming public funding calls of relevance to HU

</td></tr>
<tr><td>

Problem # mapping
Ecosystem Connectivity: 70, 71, 72, 73, 75, 77, 78, 79, 80

</td><td>

Recommendations # mapping
Market state and funding:2.5, 2.6, 2.7, 2.8
Technology Adoption and Deployment: 4.1
Ecosystem Connectivity: 5.1

</td></tr>
</table>

5.2.10 Dissemination about interoperability experiences across EU

Action Title: Dissemination about interoperability experiences across EU	**Action #:** HU10
	Action status: Planning

Action Objective / Description

This action targets the publication of case studies on interoperability best practices and worst practices scenarios. The aim is to develop, with the participation of industry, public policy makers, academic researchers and professional organisations, an online platform where case studies related to interoperability can be accessed, searched, easily interpreted and items can be added to the database according to the defined criteria.

Interoperability—the seamless exchange and use of data, information, and systems—is a cornerstone of effective collaboration in the modern energy and digital landscape. However, achieving it across diverse systems, regulations, and stakeholders remains a challenge for industries, policymakers, and academia. This action aims to tackle these challenges by creating a comprehensive repository of real-world case studies, showcasing both successful (best practices) and unsuccessful (worst practices) interoperability scenarios across the EU.

The focus will be on enabling energy stakeholders, such as grid operators, energy providers, technology developers, and policymakers, to learn from previous experiences, avoid pitfalls, and adopt solutions that enhance the efficiency and reliability of energy systems. By providing an online platform for case studies, this initiative will foster shared knowledge, innovation, and collaboration, ultimately supporting Europe's energy transition goals.

The transition to a low-carbon future depends on seamless integration across diverse energy systems, including:

- Smart grids: To coordinate renewable energy sources and maintain grid stability.
- Distributed energy resources (DERs): Such as solar panels, battery storage, and EVs, which require real-time data sharing with local and national grids.
- Energy markets: To enable transparent and efficient energy trading across borders and sectors.

Without interoperability, these systems are fragmented, leading to inefficiencies, increased costs, and missed opportunities for decarbonisation. For example, the inability of smart home energy management systems to communicate with local distribution grids can result in energy waste and grid overload during peak periods.

The platform will be a centralised hub for stakeholders to access and share knowledge, featuring:

- Sector-specific filtering: Users can search for energy-focused case studies by technology type (e.g., smart grids, DERs, EV charging) or region.
- Submission and review system: Energy stakeholders can contribute their own case studies, with a peer-review process ensuring quality and relevance.

- Visual insights: Interactive dashboards and visual tools will summarise key learnings from case studies, helping users quickly grasp essential insights.
- Multilingual support: To promote inclusivity across EU member states, the platform will support content in multiple languages.

Expected outcomes:

- A knowledge hub for the energy sector: A central repository of real-world case studies tailored to energy systems interoperability.
- Informed stakeholders: A shared understanding of effective and ineffective approaches to energy systems integration, empowering stakeholders to make informed decisions.
- Accelerated energy transition: Improved collaboration and innovation across the energy sector, supporting the EU's decarbonisation and renewable energy goals.

This initiative will pave the way for more efficient and integrated energy systems, ensuring Europe's energy sector is equipped to meet the demands of a sustainable, low-carbon future.

Action Owner & supporting stakeholders

- The coordinating entity is yet to be identified, interested parties being validated.

Next steps

Stakeholder engagement

- Identify and collaborate with key stakeholders, including industry representatives, policymakers, academic researchers, and professional organisations, to define the platform's scope and criteria.
- Organise initial meetings or workshops to gather input on interoperability challenges and potential case studies.

Platform development

- Design and develop an intuitive, user-friendly online platform that allows for case study submission, search, and review.
- Ensure the platform supports multilingual content for broader EU accessibility.

Content collection

- Compile and review initial case studies, highlighting both best and worst practices in interoperability.
- Establish a peer-review process for approving and updating entries in the database.

Awareness campaign

- Launch a dissemination campaign to promote the platform across EU member states, encouraging contributions and usage.

<table>
<tr>
<td>Deliverables / outcomes / measures
Online platform: A fully functional platform featuring an intuitive interface for accessing and submitting interoperability case studies.

Case study database: An initial repository of thoroughly vetted case studies on interoperability, showcasing best and worst practices.

Submission guidelines: A detailed set of criteria and instructions for stakeholders to add their case studies to the platform.

Awareness materials: Brochures, social media content, and informational webinars to promote the platform and encourage participation.</td>
<td>Timeframe
M1-M3 Preparation
Stakeholder engagement and definition of platform scope and criteria.

M4-M7 Development of the online platform and collection and review of case studies.

M8-M9 Launch the platform and begin the dissemination campaign.

M10-M18 On-going updates and maintenance</td>
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<tr>
<td colspan="2">Policy / Regulatory change required?: [Yes / No]
No change required</td>
</tr>
<tr>
<td>Existing funding sources
● No existing funding in place</td>
<td>Additional budget required
● Full project financing required
● Anticipated total cost: €50,000
● See Appendix 4 for upcoming public funding calls of relevance to HU

Total estimated cost: 50,000 EUR</td>
</tr>
<tr>
<td>Problem # mapping
Resilient Growth: 85, 86, 87, 88, 89, 90</td>
<td>Recommendations # mapping
Resilient Growth: 6.3, 6.4</td>
</tr>
</table>

5.2.11 Establish a working group, launch and/or strengthen the standardisation dialogue with the necessary actors

Action Title: Establish a working group, launch or strengthen the standardisation dialogue with the necessary actors	**Action #:** HU11 **Action status:** Planning

Action Objective / Description

The goal is to create recommendations for hardware requirements and standardisation of data protocols by setting up a working group and launching or strengthening the standardisation dialogue with the necessary actors. The members of the working group will receive structured dissemination of strategically relevant EU-level projects and ideas related to energy data processing (e.g., int-Interoperability Network for the Energy Transition, EnerShare: The Energy Data Space for Europe). These strategic large EU projects are developing frameworks, the content and results of which are disseminated as part of the projects themselves, but are also of particular interest to the professional community. This professional audience includes relevant stakeholders and multipliers, covering the quadruple helix model.

During this process, a common language and a shared conceptual framework will be developed; further strengthening cooperation, as well as the efficiency of joint work and dialogue.

The working group's responsibilities will include effectively and structurally presenting its findings in a document that summarises its conclusions and outlines further tasks, such as defining strategic directions and foundational principles. The conclusions formulated in this way can be incorporated into further developments.

Action Owner & supporting stakeholders	**Next steps**
The coordinating entity is yet to be identified, interested parties being validated. By involving this diverse range of stakeholders, the working group can create robust, actionable, and widely supported recommendations:	**Establish the working group** • Identify and invite key stakeholders, including industry representatives, policymakers, researchers, and civil society actors, to join the group. • Develop a terms of reference document outlining the working group’s objectives, tasks, and timelines. **Launch the standardisation dialogue**

<table>
<tr>
<td>

- industry representatives (energy companies, technology providers)
- public institutions (including municipalities)
- academic and research organisations
- professional organisations and standardisation bodies
- financial institutions and funding bodies
- civil society organisations

</td>
<td>

- Host an initial workshop to define common goals, terminology, and the conceptual framework for hardware requirements and data protocols.
- Introduce relevant EU projects and their frameworks to inform the dialogue.

Develop recommendations

- Facilitate regular meetings to draft recommendations for hardware standardisation and data protocol interoperability.

Disseminate findings

- Compile and publish a document summarising the working group's conclusions and recommended strategic directions.
- Share findings with broader professional and stakeholder communities.

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Deliverables / outcomes / measures

Established working group: A structured team with defined objectives and active participation from relevant actors.

Common framework document: A document outlining shared terminology, a conceptual framework, and strategic directions.

Recommendations: Clear, actionable guidelines for hardware requirements and data protocol standardisation.

Dissemination materials: Presentation materials and a report summarising key outcomes and directions.

</td>
<td>

Timeframe

M1–M2: Establish the working group and develop the terms of reference.

M3–M8: Conduct regular working group meetings to draft recommendations.

M9–M10: Finalise the recommendations document and dissemination materials.

M11–M12: Present findings to stakeholders and plan the next steps for implementation.

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<tr>
<td colspan="2">

Policy / Regulatory change required?: [Yes / No]
No change required

</td>
</tr>
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<td>

Existing funding sources

- No existing funding in place

</td>
<td>

Additional budget required

- Full project financing required
- Anticipated total cost: **€60,000**
- See Appendix 4 for upcoming public funding calls of relevance to HU

</td>
</tr>
</table>

Problem # mapping	**Recommendations # mapping**
Human Capital: 33, 34, 35 Resilient Growth: 85, 86, 87	Policy and Regulation: 1.1, 1.2 Human Capital: 3.4, 3.8 Resilient Growth: 6.3, 6.4

6. Ukraine

6.1 Ukraine Ecosystems Analysis: Key Problems & Recommendations

This section provides an overview of the problems identified on the previous steps of the project implementation through desk research and extensive stakeholder dialogue. Recommendations to tackle these problems were further defined in order to guide the process of planning for the national actions to be suggested for an effective and efficient energy transition in Ukraine.

The Ukrainian energy innovation ecosystem faces a range of complex challenges, driving the need for transformation across all its dimensions: infrastructure, business models, stakeholder collaboration, and more. Due to the war, Ukraine has abruptly reached the "chaos point" on a transition X-curve, highlighting the urgent need for new approaches across the energy ecosystem. Before the war, Ukraine struggled with a monopolised energy sector characterised by corruption, slow innovation, insufficient funding for new facilities development. Energy facilities damaged during the war, including nuclear and renewable generation, combined with limited storage capacity, exacerbate grid congestion issues. This critical situation demands immediate measures to restore functionality and support the daily needs of both businesses and households. Such measures often rely on readily available, non-innovative solutions, potentially compromising long-term goals for green and digital transitions in favour of cheaper, more immediate fixes. But the military aggression has elevated energy security and independence to the highest priority, emphasising the need for decentralisation and digitalization in line with EU ambitions. This presents a unique opportunity to rebuild the system based on the principles of a green, digital, and equitable transition while aligning with Ukraine's integration into the EU research, innovation, and energy markets.

Ukraine possesses significant potential for creating innovative solutions, supported by a strong academic foundation and entrepreneurial spirit. With digitalization already prioritised at the national level, leveraging this focus alongside appropriate support mechanisms could drive transformative solutions.

Regulatory restrictions, lack of employees, not sufficient funding of innovative solutions with shortage of awareness among stakeholders regarding energy digitalisation and decentralisation, especially at regional and local level because of enhanced risks caused by war, demand of community members for fast decisions to cover energy shortage make it necessary to concentrate and use all available resources and shift the mental models.

Stakeholder dialogue within the WEnnovate project allowed us to identify priority challenges, named by representatives of different stakeholder groups and suggest actions alongside with recommendations

to respond to those challenges. Following the framework of the WEnnovate project, problems are summarised across six dimensions.

6.1.1 Policy and regulations

There is a misalignment of priorities at both strategic and tactical levels, as well as between regional and national levels. The state lacks responsibility for energy transition, there is no systematic approach or coordination, with no single point of authority responsible for Green and Digital Transition. There is no current Innovation Strategy adopted, though draft strategy is prepared with green and digital transformation in line with Green Deal.

To address this, harmonisation with EU standards and the establishment of clear rules and regulations are essential. Aligning decentralisation, digitalisation, and renewable energy production with reconstruction efforts will result in significant gains for Ukraine's energy sector.

6.1.2 Market state and funding

Ukraine's monopolised and hyper-centralised energy market tends to favour projects with quick returns and fast implementation, leaving long-term, sustainable initiatives underfunded. The country struggles with a lack of financing and destroyed infrastructure, and the need for after war reconstruction and development and Ukraine's EU member state candidate status requires rethinking general economics models which will influence a choice about the energy system development instead of a ruined one. Innovation based energy and economy requires implementing nondiscriminatory public funding programs and financial instruments for both private and public actors.

6.1.3 Human capital: education, awareness, workforce

The energy sector in Ukraine faces a significant shortage of skilled employees. The system is also male dominated. This low inclusion of women causes low empathy levels and poorer decision making. Resistance to implementing innovative solutions at the local community level is defined by low awareness about the benefits of new energy technologies and lack of communication between different stakeholders. There is also a very low institutional capacity of the majority of municipalities and local communities with a shortage of adequate expertise, especially in the area of new energy technologies. The public sector requires communication campaigns and dissemination of best practices for the role models to be scaled across the country.

To address this, there is a need to create tailored industry training programs and establish shared professional centres, such as competence centres. However, ongoing military aggression has diverted

public attention, making energy transition a lower priority unless it directly aligns with energy security objectives.

6.1.4 Technology adoption and deployment

According to the European Innovation Scoreboard 2024, Ukraine is an Emerging Innovator with a performance of 32.5% of the EU average in 2024, compared to 31% in the European Innovation Scoreboard 2023. Ukraine's innovation ecosystem still needs to be strengthened, as many new projects have been put on hold due to the war. Despite this, the country's geography is well-suited for generating solar and wind energy, and Ukraine is seen as the EU Hydrogen Hub, but there are still no “ready to build” hydrogen projects.

Recently, energy efficiency solutions have been adopted across various sectors, including industry, local communities, and households. The household sector is the least penetrated with energy efficiency tools, but high energy prices may motivate households to adopt digital solutions to reduce costs. Scaling successful regional examples of energy efficiency is highly recommended. Given the high costs of new technologies, Ukraine should prioritise scaling projects that demonstrate efficiency, decentralisation, and resilience.

6.1.5 Ecosystem connectivity

There is a lack of academia and innovation ecosystems integration in the Ukrainian energy sector despite Ukraine having a robust academic foundation that is open to collaboration and partnerships. The public procurement process prevents academic institutions from cooperating with state-owned energy companies. To harness the potential of science and innovations, Ukraine should establish a working sandbox for energy companies, encouraging collaboration and fostering innovations across the industry.

6.1.6 Resilient growth

Russia is trying to destroy the Ukrainian energy system not only by rockets and drones but also through cyberattacks: malware disruptions, shutting down government websites, confusing or shutting down software directly or indirectly related to running the energy infrastructure. This causes the need for cybersecurity innovations and their wide deployment.

Decentralised energy generation and ensured cybersecurity offer significant potential, but progress is hindered by limited access to data. Access is constrained due to the lack of incentives for major players, challenges in balancing data sharing with privacy and competitive advantage concerns, and the insufficient development of data space technologies in Ukraine.

To overcome this challenge, it is proposed to establish a shared platform for data sharing and communication, facilitating more efficient collaboration and innovation.

Due to a lack of financial resources, the government is placing the burden of solving energy access issues onto consumers. Despite a high level of business engagement in social issues, companies do not prioritise addressing energy related problems in their corporate social responsibility actions. Social innovations like energy communities and energy cooperatives are seen as means to tackle these challenges.

6.1.7 Addressing key challenges

Based on the Problems / Needs analysis summary (for more details see Report of needs, problems and obstacles in countries participants, chapter on Ukraine), there is a list of recommendations developed to address these problems, which are reflected in actions of the Plan.

Establishing requirements for innovation is essential to foster the development of innovation ecosystems in Ukraine. Since consultations on the Innovation Strategy of Ukraine are still ongoing, the recommendations from the WEnnovate project could be considered for inclusion in the national strategy document. A national vision for energy sector transformation could help clarify priorities for innovation. However, due to information restrictions during wartime, public discussions of such documents are not possible until the war ends.

Establishing a single government entity to address climate and energy issues, along with restructuring ministries to focus on these priorities, could align national regulations with EU integration requirements. This includes implementing legislation in line with the EU's Fit for 55 initiative. To ensure Ukrainian companies meet EU standards domestically, communication campaigns and training programs should be developed.

Improving economic policies and fostering an entrepreneurial environment requires clear and stable economic frameworks, which is particularly challenging during wartime. However, a science-based approach to post-war rebuilding and reconstruction, guided by a shared vision, can make this feasible. Reforming household subsidies to target only those in need could incentivize digitising energy usage and encourage participation in new cooperative energy-saving and efficiency models.

To support entrepreneurship in the energy sector and promote the inclusion of underrepresented groups in energy and technology, special state and regional programs are essential. Additionally, rethinking regional Smart Specialisation Strategies with a focus on energy-efficient solutions based on renewable energy and social innovations (such as energy communities and cooperatives) could drive innovation.

All these measures are necessary prerequisites for developing effective innovation ecosystems that support the energy transition.

Development of conditions for profitable private investment instead of trying to maintain artificially low tariffs heavily relies on innovation support programs and actions. It requires implementing new financial means and instruments, attracting more EU public funding, establishing state grant programs and ensuring availability of grants for private research organisations and business.

The opportunity to replace destroyed generation facilities with decentralised, digitised energy systems is obvious to utilise. Also decentralisation will increase resilience against blackout risks.

This recommendation aligns with another key proposal: launching a national communication, awareness, and education campaign on renewable energy, led by the government, to promote decentralisation and digitalization with innovation as the core driver of these processes. Such a campaign should emphasise the role of local energy generation in enhancing energy security and reconstruction efforts, shaping public perception around these goals.

The lack of educational programs tailored to the energy transition—particularly with a focus on deep-tech and innovation management—highlights the need for collaboration among stakeholders to bridge this gap. Preparing degree programs for each alternative energy sector aligned with industry needs and state priorities is essential. In the short term, this gap could be addressed through the development of training systems, short-term university programs, and the establishment of shared professional competence centres.

Given the weak institutional capacity of many local communities in the energy sector, creating knowledge centres or centres of expertise is crucial. These centres would provide local communities and regional authorities with the knowledge and support needed for decision-making, project management, and fundraising to deploy energy technologies, including innovative solutions.

Diversity of power generation sources is important for energy security and energy independence. New technologies like nuclear small modular reactors, different types of CHPs, biogas and hydrogen fueled turbines, novel wind and solar energy generation and storage equipment require collaboration of innovation actors with territorial communities. There is also a need to support local energy partnerships and shared energy use. Implementing advanced cybersecurity measures tailored to protect the digital infrastructure of energy systems is also…

Organising regulatory sandboxes are important for testing innovative solutions in real operating conditions. Sharing tested practices will help to encourage innovation deployment. That requires pilot projects to pivot new rules before introducing wide legislative changes.

Taking data availability as a key factor for innovation ecosystem actors to proceed with commercialising technology solutions, it is important to change data sharing practices for energy sector players. It may be achieved by establishing a single shared platform for data sharing and communication among ecosystem actors and ensuring this platform is equipped with robust privacy protections and user access controls to maintain data integrity and confidentiality as well as promoting a culture of transparency and encouraging partnerships between public and private sectors. These

mechanisms will enhance data availability for research and innovation and incentivise players to share their data, increase energy security and reduce costs. Secure data sharing frameworks to facilitate patent analysis while protecting sensitive information is one more measure for increasing the pace of innovation.

6.2 Ukraine: Actions

The following actions have been suggested by the WEnnovate project for the digital energy transition in Ukraine based on the strategic alignments, stakeholders' interest, available innovative solutions and potential funding availability.

Each action suggested in the action plan varies in the level of maturity, scope of the stakeholders engaged and funding needed to be allocated. Further discussions with interested stakeholders will be organised by the WEnnovate team to facilitate actions' implementations and attracting necessary resources. Moreover, this Action plan should not be considered as an exhaustive list of actions, as some of the problems not yet been addressed due to the limitations of the current situation in Ukraine, including security reasons, policy regulations and lack of funding. Further analyses will be conducted by the Working Groups of the Ukrainian WEnnovate Policy lab to improve the suggested Action Plan and address all wider range of issues, experienced by the energy innovation ecosystem in Ukraine.

Disclaimer on Stakeholder Inclusion

The inclusion of named stakeholders in this action plan serves as an expression of interest in future collaboration and is a direct result of the extensive stakeholder engagement process. It does not represent a binding commitment by any stakeholder to undertake or participate in the actions outlined, irrespective of funding outcomes. WEnnovate project through Working Groups and Energy Transition Policy Lab in Ukraine will initiate the outlined actions and approach defined stakeholders for further actions' implementation. Stakeholder participation will be re-evaluated at the time of application for future funding opportunities, considering factors such as funding availability, specific call requirements, and the availability and capacity of consortium members. All engagements are subject to formal agreements to be established during the implementation phase.

Note on actions included with Joint Programme vs National Action Plan

Actions expected to have a broader international impact and benefit from the participation of all WEnnovate countries have been excluded from the national Action Plan and are instead included in the Joint Programme.

List of Actions prioritised for Ukraine Action Plan

1. Recommendations for Innovation strategy of Ukraine based on WEnnovate Results
2. Energy transition policy lab
3. Subsidies for innovations in energy (Program-Target Method)
4. Fostering participation in the EU Grant programs
5. National grant program for research and innovations
6. Innovation procurement
7. A program of tax incentives for businesses to stimulate investment in innovative projects
8. Creating conditions for the development of bank project financing
9. Development of financial instrument in climate finance
10. Green and sustainable bonds
11. Development of the Ukrainian capital market
12. Fostering Energy Innovation through Education Programs at the HEI
13. Training and Civic Education for Innovative Energy Solutions
14. Public Awareness and Knowledge for Energy Innovation Implementation
15. Communication strategy development
16. Communication campaign launching
17. Networking as the source for energy community building
18. Creation of competence centres in energy to pool resources
19. Supporting expert communities to improve the level of competence of professionals and project participants, evaluate projects, and provide expertise for project implementation.
20. Concept for regulatory sandboxes and experimental tools
21. Development of Operating Rules for Battery Storage for FCR and aFRR Ancillary Services in Ukraine
22. Development of International cooperation in "Energy Transition Policy Lab" to exchange experience, knowledge and expertise in the field of energy innovation
23. Development of digital energy innovations with Digital Innovation Hubs

List of Actions prioritised for Joint Programme Plan

1. Designing for new energy systems: observability, standardisation and interoperability
2. Designing for new energy systems: Grid usage and management (capacity, aggregation, flexibility & ancillary Services)
3. Facilitating international knowledge exchange for energy sharing groups (communities and hubs)

4. Best Available Technologies (BAT) Open Repository: Curating resources for the digital energy transition.
5. Advancing digital energy innovation education: Tailored training for leadership and workforce development.
6. Strengthening communication and dissemination networks for the digital energy transition
7. Fostering energy innovation ecosystems for the digital energy transition

6.2.1 Recommendations for Innovation strategy of Ukraine based on WEnnovate Results

<table>
<tr><td colspan="2">Action Title:
Recommendations for Innovation strategy of Ukraine based on WEnnovate Results</td><td>Action #: UA1
Action status: Implementing</td></tr>
<tr><td colspan="3">Action Objective / Description
To include important provisions based on WEnnovate project results in Global Innovation Vision of Ukraine https://winwin.gov.ua/</td></tr>
<tr><td colspan="2">Action Owner & supporting stakeholders
WEnnovate project partners from Ukraine (KAU, USF) and international partners</td><td>Next steps
To sign the letter (position paper) with recommendations</td></tr>
<tr><td colspan="2">Deliverables / outcomes
Recommendations supplied to Ministry of Digital Transformation of Ukraine and Ministry of Education of Science of Ukraine</td><td>Timeframe
November-December 2024</td></tr>
<tr><td colspan="3">Policy / Regulatory change required?: No</td></tr>
<tr><td colspan="2">Existing funding sources
WEnnovate project</td><td>Additional budget required
No</td></tr>
<tr><td colspan="2">Problem # mapping
Policy and Regulations: 318-325
Market state and Funding: 335</td><td>Recommendations # mapping
Policy and Regulations: 1.1-1.3, 1.7, 1.13, 1.17
Market state and Funding: 2.3
Human capital: 3.4
Technology adaptation and deployment: 4.1, 4.3, 4.4
Ecosystem connectivity: 5.6
Resilient growth: 6.6</td></tr>
</table>

6.2.2 Energy transition policy lab

<table>
<tr><td colspan="2">Action Title
Energy transition policy lab</td><td>Action Reference #: UA2
Action status: Initiated</td></tr>
<tr><td colspan="3">Action Description
The Policy Lab focuses on generating actionable outcomes through structured discussions that produce joint action plans, defining roles, responsibilities, timelines, and accountability mechanisms. It is also aimed on generating recommendations and propositions for Policy Making at governmental level
Establishing Policy Lab within the framework of the WEnnovate project
Initiating Legislation and Regulatory Changes
Developing Strategies, Action Plans and Joint Programs for Energy Transition and implementing them by uniting efforts of different stakeholders groups
Prepare recommendations for policy documents for Government and Regional Authorities</td></tr>
<tr><td colspan="2">Action Owner & supporting stakeholders
Kyiv Academic University
Ukrainian Startup Fund</td><td>Next steps
Planning projects for implementing Ukraine National Plan Activities and Joint Program Activities</td></tr>
<tr><td colspan="2">Deliverable
Energy Transition Policy Lab entity created
Projects for research based policy change are initiated</td><td>Timeframe
2024 - quarterly sessions
2025 - quarterly sessions</td></tr>
<tr><td colspan="3">Policy / Regulatory change required? No</td></tr>
<tr><td colspan="2">Existing funding sources
WEnnovate project</td><td>Additional budget required
Grant Financing
International Technical assistance</td></tr>
<tr><td colspan="2">Problems # mapping
Policy and Regulation: 318-322, 326, 328-330)
Market state and funding: (341)</td><td>Recommendations # mapping
Policy & Regulation: 1.1-1.4, 1.7, 1.8, 1.10, 1.12, 1.13</td></tr>
<tr><td colspan="3">Indicator / key metrics
Number of green and white papers for energy transition policies
Number of projects (plans, programs) initiated /implemented</td></tr>
</table>

6.2.3 Subsidies for innovations in energy (Program-Target Method)

Action Title Subsidies for innovations in energy (Program-Target Method)	**Action Reference #: UA3** **Action status**: not started/ ideation
Action Objective/ Description Development and adoption of the target program at the national level in order to stimulate innovations in the energy sector, using state budget funding. By adopting the target program on the national level, local governments will then get a clear mechanism and instrument to implement such a program on a local level. This action should be evidence-based. The expert groups should advocate the issues concerning the allocation of funds in the budget.	
Action Owner & supporting stakeholders Ministry of Energy, Ministry of Economy, The Ministry for Communities and Territories Development of Ukraine Non-government and expert organisations, think tanks, local communities	**Next steps** - Development and adoption of the target program by the ministries (Ministry of Energy, Ministry of Economy, Ministry of Regions) and by the Verkhovna Rada - Dissemination of information about the budget program (for regional and local authorities) - Implementation steps at the local level
Deliverable The Target Program is developed and adopted. Subsidies for implementing innovations in energy are allocated and provided.	**Timeframe** 2024-2025
Policy / Regulatory change required: No	
Existing funding sources Budgetary and donor funds	**Additional budget required** International technical assistance
Problems # mapping Policy and regulations: 323, 324, 328, 330 Market state and Funding: 332-335, 337 Human capital: 348-350, 352-353	**Recommendations # mapping** Policy & Regulation: 1.2, 1.3, 1.10, 1.12 Market state & Funding: 2.2

Indicator / key metrics

Amount of funds allocated in the budget of Ukraine for the Target program of subsidies for innovations in energy.

Allocated subsidies.

6.2.4 Fostering participation in the EU Grant programs

<table>
<tr><td colspan="2">Action Title
Fostering participation in the EU Grant programs</td><td>Action Reference #: UA4
Action status: Ongoing implementation</td></tr>
<tr><td colspan="3">Action Objective/ Description
Currently, there are a large number of grant programs available to Ukrainian beneficiaries. However, information about these programs is not widely available. There is also insufficient training of specialists in project development and management. Therefore action aimed at raising awareness about the available funding opportunities and increasing the institutional capacity and expertise of those applying for funding will benefit the development and deployment of deep tech energy innovations.</td></tr>
<tr><td colspan="2">Action Owner & supporting stakeholders
Regional and local authorities, NCPs, business, BSO, facilitators, innovation agencies and regional development agencies.</td><td>Next steps
• Launching an information campaign for the target audience regarding the possibilities of participation in EU grant programs
• Developing and delivering trainings for grant projects managers (trainings, workshops)
• Developing and delivering training programs for local authorities (trainings, seminars)</td></tr>
<tr><td colspan="2">Deliverable
Information Campaign
Training Programs</td><td>Timeframe
2025-2027</td></tr>
<tr><td colspan="3">Policy / Regulatory change required: No</td></tr>
<tr><td colspan="2">Existing funding sources
Funding programs</td><td>Additional budget required
Direct funding and specific actions.</td></tr>
</table>

Problems # mapping	**Recommendations # mapping**
Market state and funding: 334,335, 337 Human capital: 348 Ecosystem connectivity: 359, 362	Policy and Regulation: 1.2, 1.3, 1.10, 1.12. Market and Funding: 2.2
Indicator / key metrics Increasing grant funding of energy projects Increasing the number of projects.	

6.2.5 National grant program for research and innovations

<table>
<tr><td>Action Title
National grant program for research and innovations</td><td>Action Reference #: UA5
Action status: Planning</td></tr>
<tr><td colspan="2">Action Description
National grant programs for innovation are good practice in many innovation-prone countries. In addition, diversification of different sources of innovation funding, including co-financing of projects, is a recognized approach. Innovators in each EU country have access to both EU grant programs and their own national programs.

Ukraine, as a country with EU candidate status, needs its own Framework program for research and innovation. This will accelerate Ukraine's integration into the European Research Area.</td></tr>
<tr><td>Action Owner & supporting stakeholders
KAU and UFS advocating introduction.
Ministry of Education and Science, Ministry of Economy, Ministry of Finance, research organisations, small and medium-sized businesses, state-owned and municipal enterprises, regional and local authorities, NGOs, innovation and regional development agencies.</td><td>Next steps
- Development and approval of the National Grant Program for Research and Innovations
- Development of Action plan for its implementation
- Information support</td></tr>
<tr><td>Deliverable
Program guide and calls for proposals</td><td>Timeframe
2025-2027</td></tr>
<tr><td colspan="2">Policy / Regulatory change required: Yes</td></tr>
<tr><td>Existing funding sources
Budgetary and donor funds</td><td>Additional budget required
Direct funding and specific actions.</td></tr>
<tr><td>Problems # mapping
Policy and regulations: 320,325, 330
Market state and funding: 333, 334
Ecosystem connectivity: 359</td><td>Recommendations # mapping
Policy and regulations: 1.2, 1.3., 1.10, 1.12
Market state and funding: 2.2</td></tr>
</table>

Indicator / key metrics

Increasing the amount of funding for energy projects allocated through national programs

Increasing the number of projects.

6.2.6 Innovation procurement

<table>
<tr><td colspan="2">Action Title
Innovation procurement</td><td>Action Reference #: UA6
Action status: Ideation/planning</td></tr>
<tr><td colspan="3">Action Description
The European Commission supports innovation procurement as a tool to deliver solutions to economic and societal challenges.

In Ukraine, public procurement can create a huge market for innovative products and services, but its potential remains underutilised. Therefore, it is necessary to improve public procurement practices, promote demand for innovative products and services, and promote innovation across sectors. This will help integrate public demand into the innovation ecosystem and contribute to economic recovery.</td></tr>
<tr><td colspan="2">Action Owner & supporting stakeholders
Public authorities, budget spending units, administrators of budgetary funds, enterprises, PROZORRO system, research organisations, small and medium-sized businesses, state-owned and municipal enterprises, regional and local authorities, NGOs, innovation and regional development agencies.</td><td>Next steps
• Improving the mechanism of public procurement of innovations
• Adoption of the draft law on innovative procurement, its advocating</td></tr>
<tr><td colspan="3">Policy / Regulatory change required: Yes</td></tr>
<tr><td colspan="2">Deliverable
Law on innovative procurement adopted</td><td>Timeframe
2025-2027</td></tr>
<tr><td colspan="2">Existing funding sources
Current funding is not available for this action</td><td>Additional budget required
Budgetary and donor funds.</td></tr>
<tr><td colspan="2">Problems # mapping
Policy and regulations: 318-320, 325
Market state and funding: 334
Human capital: 349, 350, 358, 359

There is an Insufficient share of innovative procurement and Lack of innovative procurement at the local level.</td><td>Recommendations # mapping
Policy and Regulation: 1.1-1.3, 1.5, 1.10, 1.12

A more active role of the Ministry of Economy of Ukraine and regional and local authorities is seen as necessary</td></tr>
</table>

	for changes, as well as Active advocacy.
Indicator / key metrics Increase of share of innovative procurement in the energy sector. Increasing the share of innovative procurement in local communities.	

6.2.7 A program of tax incentives for businesses to stimulate investment in innovation projects

<table>
<tr><td colspan="2">Action Title
A program of tax incentives for businesses to stimulate investment in innovation projects</td><td>Action Reference # UA7
Action status: Ideation</td></tr>
<tr><td colspan="3">Action Description
Innovation-prone countries should encourage businesses to invest in innovations, especially in socially sensitive sectors that affect the impoverished population
To this end, policies should be implemented to stimulate investment and support innovation, and to encourage SMEs to invest in innovations.</td></tr>
<tr><td colspan="2">Action Owner & supporting stakeholders
Public authorities, business, enterprises of various forms of ownership, financial organisations and investment companies, innovation funds, science and industrial parks, charitable organisations.</td><td>Next steps
- Preparation of a draft law on tax incentives for profit taxation,
- Negotiating with the government and advocacy.</td></tr>
<tr><td colspan="3">Policy / Regulatory change required: Yes</td></tr>
<tr><td colspan="2">Deliverable
Law on tax incentives for profit taxation adopted</td><td>Timeframe
2025-2027</td></tr>
<tr><td colspan="2">Existing funding sources
Current funding is not available for this action</td><td>Additional budget required
Budgetary and donor funds.</td></tr>
<tr><td colspan="2">Problems # mapping
Policy and regulations: 318,319, 322
Market state and funding: 332-334, 336-338, 341
Technology adaptation and deployment: 350, 355
Ecosystem connectivity: 359
Resilient growth: 374</td><td>Recommendations # mapping
Policy and regulations: 1.1-1.3, 1.5, 1.8, 1.10, 1.12, 1.13
Market state and funding: 2.1

Introduction of incentives require more active role of the Ministry of Economy of Ukraine an innovative business and advocacy efforts</td></tr>
</table>

Indicator / key metrics

Increasing the share of investments in innovations in the energy sector.

Increase in the number of innovative projects in the energy sector.

6.2.8 Creating conditions for the development of bank project financing

Action Title Creating conditions for the development of bank project financing	**Action Reference # UA8** **Action status**: planning
Action Description Bank project financing is an important mechanism for developing public and private sector projects. Ukraine has a little experience in implementing projects through bank financing, although significant international support is being provided to implement this mechanism through Ukrainian banks. But banks need a special regulatory regime to finance projects.	
Action Owner & supporting stakeholders Banks, National Bank of Ukraine, insurance companies, business, Export Credit Agency, Ministry of Finance	**Next steps** • Reducing the tax burden on banks engaged in project financing • Creation of an effective mechanism for providing guarantees under project finance • Introduction of risk insurance in project finance
Deliverable Set of specific instruments for bank project financing and guidelines for their implementation	**Timeframe** 2025-2027
Policy / Regulatory change required: Yes	
Existing funding sources Banking sector	**Additional budget required** Donor funds. International investments.

Problems # mapping	**Recommendations # mapping**
Policy and regulations: 319 Market state and funding: 3332-334, 336, 337, 341 Technology adaptation and deployment: 353, 355 Resilient growth: 374	Policy and regulations: 1.1-1.3, 1.8, 1.10 Market state and funding: 2.1 The NBU and the Ministry of Finance have to Reconsider the position on bank project financing. Implementation of a guarantee mechanism.
Indicator / key metrics Increasing the share and number of banks that provide project financing for innovation projects. Increase in the number of innovation projects with bank project financing. A guarantee mechanism has been created.	

6.2.9 Development of financial instrument in climate finance

<table>
<tr><td>Action Title
Development of financial instrument in climate finance</td><td>Action Reference # UA9

Action status: Planning/ongoing implementation</td></tr>
<tr><td colspan="2">Action Description
As Ukraine has signed the Paris Agreement, supports the European Green Deal and twin transition (green and digital), it needs additional financial resources to implement innovative green projects and support green energy.

Countries need to attract additional public and private financing to transition to a climate-friendly economy and drive sustainable economic growth.
International climate finance should be used as a lever to incentivise climate-resilient and low-carbon investment, complementing domestic resources in developing economies.</td></tr>
<tr><td>Action Owner & supporting stakeholders
Business, enterprises of various forms of ownership, financial organisations and investment firms, ministries (Ministry of Energy, Ministry of Ecology, Ministry of Economy, Ministry of Finance), banks, National Bank of Ukraine</td><td>Next steps
• Establishment of an Emissions Trading Scheme
• Amendments to the laws on capital markets and organised commodity markets
• Restoring the practice of using the mechanism of selling emission reduction project units
• Ensuring conditions for responsible business development through the introduction of ESG reporting
• Information campaign to support the climate financing
• Training of specialists (and other stakeholders) on climate finance</td></tr>
</table>

Deliverable Establishment of Ukrainian Emissions Trading Scheme	**Timeframe** 2027
Policy / Regulatory change required: Yes	
Existing funding sources Current funding is not available for this action	**Additional budget required** Funding allocated for Strategies for the Recovery, Sustainable Development, and Digital Transformation of Small and Medium Enterprises for the Period up to 2027
Problems # mapping Policy and regulations: 319, 324, 327, 329 Market state and funding: 332 Human capital: 348 Technology adaptation and deployment: 349-355 Resilient growth: 374 There is no sufficient regulation and thus financial mechanisms for climate finance in Ukraine. The recent adoption of the climate law requires additional regulation of capital and commodity markets to introduce an emissions trading scheme.	**Recommendations # mapping** Policy and regulations: 1.2, 1.3, 1.5, 1.7, 1.8 Market state and funding: 2.2 Amendments to regulatory acts on capital markets are required. Awareness raising on climate finance and available mechanisms.
Indicator / key metrics Increasing the share of climate financing for green transition projects. Mechanism of emission trading is introduced and trading deals are set up.	

6.2.10 Green and sustainable bonds

<table>
<tr><td colspan="2">Action Title
Green and sustainable bonds</td><td>Action Reference # UA10
Action status: Planning</td></tr>
<tr><td colspan="3">Action Description
Green bonds are a type of debt classified as Socially Responsible Investment. On issuing this type of bond, a company — private or public — receives funds that must be used exclusively to finance or refinance (partly or fully) projects with a positive impact on the environment.
This problem is important in Ukraine in the context of recovery programs, in particular, the restoration of the ecological state of natural resources, and greening the economy on the principles “Build back better and greener”.</td></tr>
<tr><td colspan="2">Action Owner & supporting stakeholders
Green bond emitents, banks, investors, investment firms, insurance companies, professional capital market participants, ministries</td><td>Next steps
• Emission of a state green bonds
• Improvement of the laws on capital markets and organised commodity markets regarding investment in sustainable bonds by professional capital market participants</td></tr>
<tr><td colspan="2">Deliverable
First emission of a state green bonds</td><td>Timeframe
2025-2027</td></tr>
<tr><td colspan="3">Policy / Regulatory change required: Yes</td></tr>
<tr><td colspan="2">Existing funding sources
Current funding is not available for this action</td><td>Additional budget required
State budget and donor funds.</td></tr>
<tr><td colspan="2">Problems # mapping
Policy and regulations: 319, 329
Market state and funding: 332 333, 334, 336, 337
Technology adaptation and deployment: 351, 355

There is a lack of sufficient regulation and attractive conditions for investing in green and sustainable bonds in Ukraine.</td><td>Recommendations # mapping
Policy and regulations: 1.2, 1.3, 1.5, 1.7, 1.8
Market state and funding: 2.2

Amendments to regulatory acts on capital markets are required.
Awareness raising on green finance and green bonds through Information</td></tr>
</table>

	campaign for the target audience is necessary
Indicator / key metrics Green bonds emissions at national and regional levels.	

6.2.11 Development of the Ukrainian capital market

Action Title Development of the Ukrainian capital market	**Action Reference # UA11** **Action status**: ongoing implementation
Action Description Ukraine's capital market was established in the 1990s, but it has not yet taken an important place in the financial sector. A functioning capital market is a prerequisite for attracting investment, both domestic and international. Currently, Ukraine is dependent on external financing, so the development of the capital market is a necessary condition for the successful recovery of Ukraine's economy and its energy sector.	
Action Owner & supporting stakeholders Emitents, investment firms, professional capital market participants, banks, exchanges, startups, investors, regulators	**Next steps** • Amendments to the law on capital markets and organised commodity markets in accordance with the EU Regulations and Directives • Development of the capital market trading systems and platforms • Development and adoption of bylaws on trading rules, etc.
Deliverable Amendments to the Law of Ukraine On State Regulation of Capital Markets and Organized Commodity Markets	**Timeframe** 2024-2027
Policy / Regulatory change required: Yes	
Existing funding sources Current funding is not available for this action.	**Additional budget required** State budget and donor funds.

Problems # mapping	**Recommendations # mapping**
Policy and regulations: 319, 328 Market state and funding: 333, 334, 337, 338, 340, 341 Technology adaptation and deployment: 351 Resilient growth: 372	Policy and regulations: 1.5, 1.7, 1.8 Amendments to regulatory acts on capital markets are required Awareness should be raised through Information campaign for the target audience and trainings for professionals are necessary
Indicator / key metrics Increasing the number of capital market participants. Increasing the range of financial instruments. Number of innovation projects with investments.	

6.2.12 Fostering Energy Innovation through Education Programs at the HEI

Action Title: Fostering Energy Innovation through Education Programs at the HEI	**Action #: UA12** **Action status:** Ideation

Action Objective / Description

This initiative aims to enhance educational programs at HEIs to develop a new generation of professionals with the skills and knowledge necessary for advancing technology in the energy sector. The focus is on integrating innovative energy solutions into curricula, fostering interdisciplinary research, and creating partnerships with industry leaders to provide students with hands-on experience. This action seeks to drive sustainable energy innovation and contribute to national innovation energy goals.

Key Actions:

- Increasing investment in renewable energy education through grant programs for HEIs.
- Implementing educational programs and courses focused on the latest technologies and innovative energy solutions.
- Developing international cooperation through the involvement of foreign teachers and tandem teaching (synchronous simultaneous classes with both Ukrainian and international teachers).
- Implementing internationally recognized forms of knowledge assessment.
- Creating educational and research hubs (Innovation Hubs) at HEIs where students and faculty can pursue projects and research in innovative energy solutions.
- Establish Industry Partnerships: Build connections with energy sector companies and technology providers to create opportunities for hands-on student experience, internships, and mentorship.
- Pilot Implementation and Evaluation: Launch pilot courses at selected HEI`s and assess effectiveness, gathering feedback from students and faculty for improvements.
- Scale-Up Strategy: Develop a plan for expanding successful programs to additional HEIs, creating a nationwide network of innovation-focused education programs

Action Owner & supporting stakeholders	**Next steps**
Higher Education Institutions (HEIs): Lead the design and implementation of educational programs, training modules, and outreach activities focused on energy innovation. **Energy Sector Companies and Technology Providers**: Provide expertise, resources, and funding, as well as practical training, internships, and mentorship opportunities for students and	• Identify direct implementers (representatives from HEI`s, industry, and civil society) • Identify funding and resources for future implementation. • Planning and scheduling the action for the implementation phase

<table>
<tr><td>professionals.

Media Outlets: Assist in disseminating educational materials, public awareness campaigns, and event coverage to maximise the impact of outreach efforts.
A consortium of participating HEIs, local authorities, NGOs, and private sector partners will be formed to coordinate, share resources, and streamline the implementation of these initiatives. Each member will have a clearly defined role in supporting the overall action plan and contributing expertise, funding, and resources as needed.</td><td></td></tr>
<tr><td>Deliverables / outcomes
New educational programs at HEIs
Innovation Hubs at HEIs
Hackathons held by HEIs</td><td>Timeframe
2025-2026</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No</td></tr>
<tr><td>Existing funding sources
Current funding is not available for these actions</td><td>Additional budget required
- Program development and curriculum enhancement at HEIs (EUR 7000 per program);
- Establishment of Innovation Hubs at HEIs (EUR 45000 per HEI);
- Project Monitoring, Evaluation, and Reporting (EUR 2500).</td></tr>
<tr><td>Problem # mapping
Human capital: 342, 343, 347, 348</td><td>Recommendations # mapping
Human capital: 3.4, 3.5, 3.6, 3.7</td></tr>
<tr><td colspan="2">Indicator / key metrics
● Number of new educational programs;
● Contingent of students;
● Number of international programs;
● Number of tandem courses in innovation in the energy area;
● Number of researchers in energy;
● Number of scientific developments protected by patents or copyright certificates;
● Number of events;
● Number of developed solutions;
Number of programs using simulation (virtual and augmented reality) technologies in the educational process</td></tr>
</table>

6.2.13 Training and Civic Education for Innovative Energy Solutions

<table>
<tr><td>Action Title:
Training and Civic Education for Innovative Energy Solutions</td><td>Action #: UA13
Action status: Ideation</td></tr>
<tr><td colspan="2">Action Objective / Description
This initiative focuses on training specialists and raising community awareness to support the implementation of innovative energy solutions. Through targeted training programs, professionals in the energy sector will gain practical knowledge of new technologies, policies, and sustainable development practices. Additionally, civic education efforts will inform the public about the benefits and importance of energy innovation, building a strong foundation for technological progress. This dual approach aims to empower both professionals and citizens to contribute to energy transformation.

Key Actions:
• Conducting hackathons and innovation marathons to develop solutions to current energy challenges.
• Organising thematic seminars and workshops for discussions with leading experts in innovative technologies.
• Utilising simulation technologies, such as virtual and augmented reality, to teach innovative energy technologies.
• Establishing scientific and educational innovation hubs to facilitate collaboration between science, business, and education sectors.
• Scaling simulation-based educational technologies.
• Develop Specialised Training Modules: Create targeted training programs for professionals in the energy sector and civic education modules that highlight the benefits of innovative energy solutions.
• Develop partnerships network with local authorities and NGOs: partnerships with local governments and nonprofits organisations should help reach communities and ensure the widespread delivery of educational content.</td></tr>
<tr><td>Action Owner & supporting stakeholders
Higher Education Institutions (HEIs): Lead the design and implementation of educational programs, training modules, and outreach activities focused on energy innovation.

Non-Governmental Organisations (NGOs): Contribute expertise and resources for community education, coordinate public awareness campaigns, and deliver educational content to diverse audiences.</td><td>Next steps
• Identify direct implementers (representatives from HEI`s, industry, and civil society)
• Identify funding and resources for future implementation.
• Planning and scheduling the action for the implementation phase</td></tr>
</table>

<table>
<tr><td>Energy Sector Companies and Technology Providers: Provide expertise, resources, and funding, as well as practical training, internships, and mentorship opportunities for students and professionals.

Local Authorities: Support outreach efforts, civic education, and local engagement in energy awareness initiatives, including permitting and co-organizing community events.

Media Outlets: Assist in disseminating educational materials, public awareness campaigns, and event coverage to maximise the impact of outreach efforts.</td><td></td></tr>
<tr><td>Deliverables / outcomes
Tandem courses in innovation in the energy area;
Programs using simulation (virtual and augmented reality) technologies in the educational process;
Public lectures, number of involved participants;
Specialised Training Modules</td><td>Timeframe
2025-2026</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No</td></tr>
<tr><td>Existing funding sources
Current funding is not available for these actions</td><td>Additional budget required
• Development training programs and civic education initiatives (EUR 3500 per program);
• Public Awareness Campaigns and Media Outreach (EUR 5000);
• Project Monitoring, Evaluation, and Reporting (EUR 2500).</td></tr>
<tr><td>Problem # mapping
Human capital: 342-345</td><td>Recommendations # mapping
Human capital: 3.1, 3.3, 3.6</td></tr>
<tr><td colspan="2">Indicator / key metrics
• Number of tandem courses in innovation in the energy area;
• Number of events;
• Number of programs using simulation (virtual and augmented reality) technologies in the educational process;
• Number of public lectures, number of involved participants.</td></tr>
</table>

6.2.14 Public Awareness and Knowledge for Energy Innovation Implementation

<table>
<tr><td>Action Title:

Public Awareness and Knowledge for Energy Innovation Implementation</td><td>Action #: UA14

Action status: Ideation</td></tr>
<tr><td colspan="2">Action Objective / Description
This initiative aims to increase public understanding of energy innovation through comprehensive information and education campaigns. By providing accessible information on the benefits of adopting new energy technologies, the program encourages community involvement and builds public support for sustainable energy practices. Educational materials, seminars, and outreach activities will engage citizens of all ages, fostering a culture of innovation and energy awareness to accelerate the transition to clean energy solutions.

Key Actions:
• Developing and disseminating educational programs (such as online lectures and public events) focused on energy efficiency and renewable energy technologies.
• Sharing infographics and video materials through social media and the Internet to popularise innovative energy technologies.
• Partnering with public organisations to conduct information campaigns and events on innovative energy solutions.
• Launching a national energy literacy campaign to inform citizens about the importance of energy efficiency and renewable energy sources.</td></tr>
<tr><td>Action Owner & supporting stakeholders
Media Outlets; Assist in disseminating educational materials, public awareness campaigns, and event coverage to maximise the impact of outreach efforts.
A consortium of participating HEIs, local authorities, NGOs, and private sector partners will be formed to coordinate, share resources, and streamline the implementation of these initiatives. Each member will have a clearly defined role in supporting the overall action plan and contributing expertise, funding, and resources as needed.</td><td>Next steps
• Identify direct implementers (representatives from HEI`s, industry, and civil society)
• Identify funding and resources for future implementation.
• Planning and scheduling the action for the implementation phase</td></tr>
<tr><td>Deliverables / outcomes
Public campaigns, incl. open lectures and public events to increase the level of awareness of society about innovative solutions in energy efficiency, energy saving, and renewable energy,</td><td>Timeframe
2025-2026</td></tr>
</table>

<table>
<tr><td>National energy literacy campaign
Awareness survey report</td><td></td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No</td></tr>
<tr><td>Existing funding sources
Current funding is not available for these actions</td><td>Additional budget required
Public Awareness Campaigns and Media Outreach (EUR 5000);
Project Monitoring, Evaluation, and Reporting (EUR 2500).</td></tr>
<tr><td>Problem # mapping
Policy and regulations: 327, 329
Human capital: 344-346
Ecosystem connectivity: 361, 362
Resilient growth: 371</td><td>Recommendations # mapping
Human capital: 3.1, 3.3, 3.6</td></tr>
<tr><td colspan="2">Indicator / key metrics
Number of events;
Number of public lectures, number of involved participants;
Level of energy consumption per capita;
Renewable Energy Awareness index</td></tr>
</table>

6.2.15 Communication strategy development

<table>
<tr><td>Action Title:

Communication strategy development</td><td colspan="2">Action #: UA15

Action status: Ideation</td></tr>
<tr><td colspan="3">Action Objective / Description
1. Communication strategy development should include the following:
<u>1. Stakeholder engagement:</u>
- Identification and engagement of the key stakeholders, including government agencies, industry leaders, researchers, and investors.
- Hosting regular forums, workshops, and webinars to update stakeholders on progress and gather feedback.
<u>2. Building of the public relations and media:</u>
- Development a comprehensive media strategy to highlight major achievements and breakthroughs.
- Press releases, articles, and interviews conducted to generate public interest and awareness.
- Leveraging social media platforms to share updates, success stories, and insights.
<u>3. Content creation with the focus on deep tech in the energy sector:</u>
- Producing informative and visually engaging content, such as infographics, videos, and white papers, to explain deep technologies and their impact on the energy system.
- Sharing case studies and testimonials from early adopters and partners to illustrate real-world applications and benefits for the energy sector.
<u>4. Communication channels to be used:</u>
a) Digital media:
I. Website: create a dedicated campaign web page with information, updates, and resources.
Ii. Social media: use platforms like LinkedIn, Twitter, and Facebook to share news, updates, and engaging content.
iii. Email campaigns: send targeted newsletters and updates to subscribers and stakeholders.
b) Traditional media:
i. Press releases: distribute to industry and mainstream media outlets. create a dedicated campaign web page with information, updates, and resources.
ii. Media briefings: organise press conferences or briefings to provide detailed information and answer questions.
Iii. Industry publications: place articles, op-eds, and advertisements in relevant journals and magazines.</td></tr>
<tr><td colspan="2">Action Owner & supporting stakeholders
The proposed actions should be implemented by the most active representatives dealing with communication and marketing, in particular within the QH model:
● Representatives of the working group of government officials</td><td>Next steps
● Identifying direct implementers
● Identifying funding sources for the further implementation
● Planning & scheduling the actions for the implementation phase</td></tr>
</table>

<table>
<tr><td>Representatives of civil society
Industry leaders
Academia
It is extremely important to involve the stakeholders who are not only authorised to deal with communication within the relevant stakeholder group, but more importantly - to involve those who are effective implementers, not because of the external force, but because they are interested in the changes that need to be made in the innovation ecosystem dedicated to the energy sector. It is also useful to involve the media.</td><td></td></tr>
<tr><td>Deliverables / outcomes
Communication strategy (public report)</td><td>Timeframe
2024 - 2025</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No</td></tr>
<tr><td>Existing funding sources
Current funding is not available for these actions</td><td>Additional budget required
Development of the communication strategy - between €8,000 and €25,000 depending on the number of content tracks (e.g. energy policy communication strategy, funding track, etc.).</td></tr>
<tr><td>Problem # mapping
Policy and regulations: 327, 329
Human capital: 344-346
Ecosystem connectivity: 361, 362
Resilient growth: 371

The common problem with stakeholder engagement is the low level of engagement itself. Those who are engaged are not ready to contribute significantly to the project. Under these circumstances, even a small number of active and effective stakeholders drive the process quite well. Therefore, Wennovate's motto in relation to stakeholder engagement is about quality, not quantity</td><td>Recommendations # mapping
Policy and regulations: 1.18
Human capital: 3.1
Ecosystem connectivity: 5.1-5.3, 5.6
Resilient growth: 6.1

Written documents can provide evidence of the approaches chosen to manage the communication track, as well as confirming the visible results of the actions implemented.</td></tr>
<tr><td colspan="2">Indicator / key metrics
Number of stakeholders ready to implement the strategy
Funding available for the suggested communication strategy</td></tr>
</table>

6.2.16 Communication campaign launching

Action Title:	**Action #: UA16**
Communication campaign launching	**Action status:** Ideation

Action Objective / Description

1. Firstly, it is essential to define campaign objectives:
   - Raising awareness about new deep tech innovations in the energy sector.
   - Educating stakeholders about the benefits and potential of deep technologies.
   - Generating interest among target audiences.
   - Driving actions, such as investments, partnerships, or policy support.

2. To specify the target audience in focus:
   - industry leaders: Energy companies, technology firms, and startups.
   - policymakers: Government officials, regulatory bodies, and policy advisors.
   - Researchers and academics: Universities and research institutions.
   - Investors: Venture capitalists, private equity firms, and angel investors.
   - Media, environmental organizations, and interested citizens.

3. Creating detailed profiles for each target segment to tailor messaging and engagement strategies

4. Crafting messages:
   - Highlight breakthrough technologies and their potential impact on the energy sector.
   - Emphasize the advantages of these technologies, such as sustainability, efficiency, and economic growth.
   - Encourage stakeholders to participate, invest, or support the innovation agenda.
   - Developing supporting messages:
     - For industry leaders: focus on collaboration opportunities and competitive advantages.
     - For policymakers: emphasize the need for supportive policies and funding to boost the deep tech innovations in the energy sector.
     - For investors: highlighting investment opportunities and potential returns.
     - For civil society: communicate the broader societal and environmental benefits.

5. Communication channels to be used:
   - Digital media:
     - Website: create a dedicated campaign web page with information, updates, and resources.
     - Social media: use platforms like LinkedIn, Twitter, and Facebook to share news, updates, and engaging content.
     - Email campaigns: send targeted newsletters and updates to subscribers and stakeholders.
   - Traditional media:
     - Press releases: distribute to industry and mainstream media outlets.
     - Media briefings: organize press conferences or briefings to provide detailed information and answer questions.

<table>
<tr><td colspan="2">

Industry publications: place articles, op-eds, and advertisements in relevant journals and magazines.

<u>6. Events and engagement</u>:

Launch events like webinars and panels online and in-person events to discuss innovations and trends with experts and stakeholders.
Workshops and conferences conducted to engage with energy experts and academics through targeted workshops and conferences.
Content creation: infographics and videos; case studies and testimonials; content distribution plan; media outreach;

<u>7. Engagement and Interaction:</u>

Foster two-way communication:

Engage with followers, respond to inquiries, and participate in relevant conversations.
Feedback mechanisms to collect and analyze feedback from stakeholders to gauge campaign effectiveness and make improvements.

Monitor and evaluate through track performance and measure success

</td></tr>
<tr><td>Action Owner & supporting stakeholders
Representatives of the working group of government officials
Representatives of civil society
Industry leaders
Academia</td><td>Next steps
Identifying direct implementers
Identifying funding sources for the further implementation
Planning & scheduling the actions for the implementation phase</td></tr>
<tr><td>Deliverables / outcomes
Communication campaign (visuals, publications, etc.)</td><td>Timeframe
2024 - 2025</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No</td></tr>
<tr><td>Existing funding sources
Current funding is not available for these actions</td><td>Additional budget required
Networking involves organising a number of events. Depending on the number of people to be invited, the venue to be rented, the speakers to be involved, etc., the budget required will vary. The approximate budget per event varies from €5,000 to €20,000. Once the key criteria for the events have been selected, more precise pricing will be provided.</td></tr>
<tr><td>Problem # mapping
Policy and regulations: 327, 329
Human capital: 344-346
Ecosystem connectivity: 361, 362
Resilient growth: 371</td><td>Recommendations # mapping
Policy and regulations: 1.18.
Human capital: 3.1.
Ecosystem connectivity: 5.2, 5.3, 5.6
Resilient growth: 6.1</td></tr>
</table>

Indicator / key metrics

1. Reach and engagement
   Impressions: Total number of times the content is displayed.
   Reach: Unique users who have seen the content.
   Engagement rate: likes, shares, comments, and interactions divided by total reach or impressions.
   Follower growth: increase in followers on social media platforms over time.
2. Content Performance
   Click-through rate (CTR):
   Percentage of users who clicked on a specific link versus the total number who viewed it.
   Conversion rate: percentage of users who completed a desired action (e.g., signing up for a newsletter, making a purchase).
   Time on page: average duration users spend on your content, indicating engagement levels.
3. Audience insights
   Demographics: Analysis of audience characteristics (age, gender, location).
   Customer feedback: qualitative data from surveys or interviews about audience perceptions.
   Net promoter score (NPS): measures customer loyalty and satisfaction based on their likelihood to recommend the brand.
4. Media Coverage and PR
   Mentions: Number of times the brand is mentioned in media outlets.
   Sentiment analysis: assessing the tone of media coverage (positive, negative, neutral).
   Share of voice: presence in media compared to competitors.
5. Sales and revenue metrics
   Sales growth: increase in sales during the campaign period compared to previous periods.
   Return on investment (ROI): Revenue generated from the campaign divided by the campaign costs.
6. Website and Digital Performance
   Website Traffic: Increase in visitors during and after the campaign.
   Bounce Rate: Percentage of visitors who leave the site after viewing only one page.
   Lead Generation: Number of leads captured through forms or downloads.
7. Campaign-Specific Metrics
   Event Attendance: Number of participants in events or webinars.
   Email Open and Click Rates: Percentage of recipients who opened and clicked links in email campaigns.
8. Long-term Impact
   Brand Awareness: Surveys or studies measuring awareness before and after the campaign.
   Customer Retention Rate: percentage of customers who return after the campaign.

6.2.17 Networking as the source for energy community building

<table>
<tr><td>Action Title

Networking as the source for energy community building</td><td>Action Reference #: UA17

Action status: ideation</td></tr>
<tr><td colspan="2">Action Description
Networking as the source for energy community building should include the following:
1. Stakeholder identification:
• Industry leaders: Companies: Energy firms, technology providers, and manufacturers.
• Executives: CEOs, CTOs, and innovation officers.
• Startups and entrepreneurs.
• Researchers and academics.
• Policymakers
• Investors
• Public and media
• Civil society organisations focused on sustainability and energy issues (associations, NGOs and other civil society organisations).
2. Networking strategies:
• Events and conferences as the key tools to fruitful networking
• Networking platforms: professional networks (e.g., LinkedIn groups and industry-specific forums) and online communities/collaborative platforms focused on energy innovations.
• Strategic partnerships: industry alliances & public-private partnerships.
3. Tools and Resources:
• Networking Software:
O CRM systems & event management tools
• Information sharing platforms:
O Maintain and access databases of research, case studies, and industry reports.
O Use platforms like Slack or Microsoft Teams for real-time communication and project management.
4. Feedback and Evaluation Surveys and polls help to gather feedback from participants to assess the effectiveness of networking.
o Impact measurement: evaluate the success of networking activities in terms of new partnerships, collaborations, and innovation adoption.</td></tr>
<tr><td>Action Owner & supporting stakeholders
• Representatives of the working group of government officials
• Representatives of civil society
• Industry leaders
• Academia</td><td>Next steps
• Identifying direct implementers
• Identifying funding sources for the further implementation
• Planning & scheduling the actions for the implementation phase</td></tr>
</table>

<table>
<tr><td>Deliverable
Networking (memorandums, partnership agreements to be signed, events photos, guest lists (registered/visited), etc.)</td><td>Timeframe
2024 - 2025</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No</td></tr>
<tr><td>Existing funding sources
Current funding is not available for these actions</td><td>Additional budget required
The launch of the communication campaign requires a budget depending on the different communication channels to be used (social media, email, PR, advertising, etc.) - up to €40,000.</td></tr>
<tr><td>Problems # mapping
Human capital: 344-346
Ecosystem connectivity: 361, 362
Resilient growth: 371</td><td>Recommendations # mapping
Human capital: 3.1
Ecosystem connectivity: 5.1, 5.2, 5.3, 5.6
Resilient growth: 6.1.</td></tr>
<tr><td colspan="2">Indicator / key metrics
1. Growth in connections
New contacts: Number of new contacts made in a given period.
Networking event attendance: Total number of events attended and new connections made at each.
2. Engagement levels
Follow-up interactions: Number of follow-up meetings, calls or emails with new contacts.
Response rate: Percentage of contacts who respond to outreach efforts.
3. Quality of contacts
Relevance of leads: Assessment of how well new contacts match your objectives (industry, influence, etc.).
Depth of relationships: Frequency of meaningful conversations or collaborations with contacts.
4. Opportunities created
Referrals generated: Number of referrals or introductions to potential customers or partners.
Collaborative Projects: Number of joint initiatives or projects resulting from networking efforts.
5. Engagement on social platforms
Social media connections: Growth in followers or connections on platforms such as LinkedIn.
Engagement metrics: Likes, comments and shares on networking-related posts.
6. Event metrics
Event feedback: Attendee feedback or satisfaction ratings from networking events.
Attendance vs. Registration Rate: Percentage of registered attendees who actually attended.
7. Personal Branding
Online presence: Growth in website traffic or social media followers as a result of networking.
Mentions and Tags: Number of times you are mentioned or tagged by new connections on social media.
8. Long-term impact</td></tr>
</table>

Return on investment (ROI): Measure the tangible results of networking (e.g. new customers, partnerships) against the costs (time, money).

Contact retention rate: Percentage of contacts that remain engaged over time.

9. Learning and development

Skills acquisition: New skills or knowledge gained through networking opportunities or discussions.

Industry Insights: Valuable insights or trends gained from discussions with peers.

10. Regular review

Track progress: regular intervals need to be set to review networking activities and outcomes.

6.2.18 Creation of competence centres in energy to pool resources

<table>
<tr><td colspan="2">Action Title
Creation of competence centres in energy to pool resources</td><td>Action Reference #: UA18

Action status: Started</td></tr>
<tr><td colspan="3">Action Description
Information collection and mapping of specialised centres of competence in energy
Pilot projects of partners on the creation of centres of competence for the implementation of new innovative technologies (EDIH Kyiv Hi-Tech, Energy Resource Center of UKA)
Establishing interaction with other centres of competence in energy
Informing potential stakeholders and consumers
Development and implementation of a certification system for specialists in the field of innovative energy technologies.
Implementation of projects in the field of sustainable energy. Description of best practices.
Training, dissemination of knowledge. Educational and educational-methodological programs on energy efficiency and the use of renewable technologies</td></tr>
<tr><td colspan="2">Action Owner & supporting stakeholders
Kyiv Academic University
Competence centre in the EDIH Kyiv HiTech
Resource Energy Center of the UCA - combining resources with clusters, in particular the Digital Energy Cluster
Consortium “Distributed Generation” KAU jointly with Institute of Engineering Thermophysics of NAS of Ukraine</td><td>Next steps
Networking meeting between competence centres from different countries that have already been established and are being established. (Formation of a network of centres, exchange of practices, formation of joint projects)</td></tr>
<tr><td colspan="2">Deliverable
The competence centre EDIH “Kyiv HiTech” has been created, the activities carried out by the centre have begun. Contacts (local and international) between competence centres have been established (memorandum or other documents)</td><td>Timeframe
2025 - launch competence centres (EDIH Kyiv Hitech competence centre created, contacts are established with other centres, an international meeting was held within the framework of Policy Lab Wennovate)
2026 - development of interaction, joint activities (develop services, launch projects and cooperation activities.)</td></tr>
<tr><td colspan="3">Policy / Regulatory change required?: No</td></tr>
</table>

Existing funding sources EDIH's own resources to launch competence centres, we are looking for grants to develop services, launch projects and cooperation activities.	**Additional budget required** Funds are needed for coordination, analytical work (12 PM) per year Funds for the formation of joint projects (grant support, services/project management) - 6 PM per year
Problems # mapping Policy and regulations: 321, 328 Market state and funding: 337 Human capital: 345, 347, 348 Technology adaptation and deployment: 350 Ecosystem connectivity: 361	**Recommendations # mapping** Policy and regulations: 1.3, 1.6, 1.10, 1.11, 1.15, 1.16 Human capital: 3.2., 3.6., 3.7 The contacts and activities of the competence centres should be described in some way, preferably in a memorandum or other similar document.
Indicator / key metrics Number of services offered by competence centres, number of services provided, number of projects, number of stakeholders covered	

6.2.19 Supporting expert communities to improve the level of competence of professionals and project participants, evaluate projects, and provide expertise for project implementation.

<table>
<tr><td>Action Title
Supporting expert communities to improve the level of competence of professionals and project participants, evaluate projects, and provide expertise for project implementation.</td><td>Action Reference #: UA19
Action status: Planning</td></tr>
<tr><td colspan="2">Action Description
• Information gathering and mapping of expert communities in energy
• Creation of an expert community of WG6 and “PolicyLab” together with UCA and other interested participants
• Establishment of connections and cooperation between expert communities
• Establishment of interaction with platforms, clusters and other organisations that require expert services
• Involvement of expertise of organisations and specialists from other countries
• Participation in the development and audit of strategies and roadmaps for cities and regional community development
• Interaction in the network to disseminate expert knowledge and provide expert services (conducting thematic events with the involvement of potential consumers)</td></tr>
<tr><td>Action Owner & supporting stakeholders
Universities, research institutes, installation and service companies, UKA, self-regulating public organisations, the Accreditation Agency, international partners and donor organisations</td><td>Next steps
• Information gathering and mapping of expert communities in energy
• Creation of an expert community of WG6 and “PolicyLab” together with UCA and other interested participants</td></tr>
<tr><td>Deliverable
- Expert community of WG6 and "Policy Lab" together with the Ukrainian Cluster Alliance and other interested participants established
- List of energy expert communities</td><td>Timeframe
2025-local level
2026 - international level</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: No</td></tr>
</table>

Existing funding sources Resources available within running projects	**Additional budget required** Coordination - 12 PM Analysis -12 PM Expert services support - 36 PM
Problems # mapping Policy and regulations: 321, 328 Market state and funding: 337 Human capital: 347, 348 Ecosystem connectivity: 361 Insufficient level of expertise involved in the preparation and implementation of energy projects or assessment of project implementation. Lack of access to qualified personnel and individual specialists at the local level. The need for educational and methodical centres to improve the qualifications of workers and educate the youth. Lack of expert knowledge to overcome challenges at various levels (communities, enterprises, universities).	**Recommendations # mapping** Policy and regulations: 1.3, 1.6, 1.11, 1.15,1.16 Human capital: 3.5, 3.6, 3.7
Indicator / key metrics The number of expert communities and involved experts, the number of services provided by experts	

6.2.20 Concept for regulatory sandboxes and experimental tools

Action Title Concept for regulatory sandboxes and experimental tools	**Action Reference #: UA20** **Action status:** Started

Action Description

This action implies the following steps

1. Conducting research and providing recommendations on the use of the "regulatory sandbox" with specific suggestions for the energy sector
2. Developing the concept. Since regulatory experiments involve certain deviations from specific regulatory requirements regarding the powers of regulatory bodies, the concept should be based on a three-stage model, specifically:
    a. First Stage: This stage should include amendments to the laws of Ukraine (i.e., acts of the Ukrainian Parliament) to empower the Cabinet of Ministers of Ukraine (as the highest executive authority) and other regulatory bodies to conduct regulatory experiments.
    b. Second Stage: The concept should outline the basic requirements for executive acts, which must establish the fundamental conditions for conducting regulatory experiments.
    c. Third Stage: This stage should provide organisational, technological, and financial regulations for initiating, organising, and conducting regulatory experiments, as well as for overseeing these experiments and verifying their results. The corresponding regulations should define the status and powers related to conducting regulatory experiments for regulatory bodies and other interested parties. These parties should act as initiators and participants in the regulatory experiments.

Concept development should use recommendations of Commission staff working document (SWD(2023) 277/2 final) and additional provisions proposed within WEnnovate project framework:

- The Possibility of Initiating and Conducting Regulatory Experiments at the Local Government Level. This includes exploring models for Citizen Energy Communities (CEC), Renewable Energy Communities (REC), and other forms of Integrated Local Energy Communities (ILEC).
- Specific Provisions for ILEC: Relevant initiators and participants should be granted regulatory powers to conduct more advanced regulatory experiments. These experiments would focus on the establishment of Energy Hubs based on multi-energy systems, integrating multiple energy types (electricity, thermal energy and cooling, natural gas, potable water, and others).

Furthermore, initiators and participants should have capacity to organise and conduct regulatory experiments spanning multiple sectors, such as energy, mobility, and beyond. For these cross-sectoral regulatory experiments, the concept should stipulate additional conditions, including:

- An expanded participant composition - to ensure adequate representation of all relevant stakeholders.
- Enhanced organisational requirements - to facilitate the practical execution of complex, multi-sectoral experiments.
- Comprehensive evaluation criteria - to accurately assess the practical implications and results of the experiments.

<table>
<tr><td colspan="2">These additional provisions aim to broaden the scope and impact of regulatory experiments, ensuring their alignment with modern energy and sustainability goals</td></tr>
<tr><td>Action Owner & supporting stakeholders
Laboratory of open innovation ecosystems of KAU
The Club of Economists NGO
Ministry of Economy of Ukraine
Ministry of Energy of Ukraine
The Committee on Energy, Housing and Communal Services of Verkhovna Rada of Ukraine
All-Ukrainian Association of Local Governments «ASSOCIATION OF AMALGAMATED TERRITORIAL COMMUNITIES
UKRAINIAN ASSOCIATION OF DISTRICT AND REGIONAL COUNCILS
All-Ukrainian Association of Local Self-Government Bodies
Regulatory Bodies</td><td>Next steps
Preparation of a Working Draft
Develop an initial draft of the concept.
Stakeholder Workshops
Conduct multiple workshops with representatives of potential stakeholder groups to gather input and refine the draft.
Draft Refinement and Public Disclosure
Incorporate feedback from initial discussions, refine the draft, and make it publicly available for further input from a broader audience.
Finalisation and Submission
Finalise the draft concept and submit it to the Parliament of Ukraine, the Cabinet of Ministers, and key regulatory authorities for consideration.
Information Support for Review and Approval
Provide ongoing communication and advocacy to support the document during the review and approval process by legislative and executive bodies.</td></tr>
<tr><td>Deliverable
Concept adopted</td><td>Timeframe
2025 – conducting research
2026 – concept developed and approved by authorities</td></tr>
<tr><td colspan="2">Policy / Regulatory change required?: Yes</td></tr>
<tr><td>Existing funding sources
International technical assistance
Grants
Conducting research and providing recommendations on the use of the "regulatory sandbox" tool is included in Operational action plan for the implementation of the 2024–2027 Strategy for the Recovery, Sustainable</td><td>Additional budget required
Funds are needed for research, stakeholders meetings and consultation, Advisory from EU organisations
Total Budget – EUR 50000</td></tr>
</table>

Development, and Digital Transformation of Small and Medium Enterprises for 2025 with responsibility of Ministry of Economy	
Problems # mapping Policy and regulations: 318, 319 Technology adaptation and deployment: 350	**Recommendations # mapping** Policy and regulations: 1.1., 1.2, 1.3, 1.7, 1.10, 1.15, 1.16 Human capital: 3.2, 3.6 Ecosystem connectivity: 5.2, 5.5
Indicator / key metrics New policy introduced Number of projects piloted in regulatory sandboxes	

6.2.21 Development of Operating Rules for Battery Storage for FCR and aFRR Ancillary Services in Ukraine

Action Title Development of Operating Rules for Battery Storage for FCR and aFRR Ancillary Services in Ukraine	**Action Reference #: UA21** **Action status:** Ideation
Action Description The primary goal of this project is to develop comprehensive operational rules for battery energy storage systems (BESS) to provide Frequency Containment Reserve (FCR) and Automatic Frequency Restoration Reserve (aFRR) ancillary services in Ukraine. By installing and testing a 44 MW battery storage system, the project will establish a framework for reliable ancillary service delivery aligned with the technical standards of the Ukrainian Transmission System Operator (TSO). The project addresses significant regulatory and technical gaps in the current energy infrastructure, focusing on the development of an Automatic Storage and Dispatch Response (ASDR) terminal to meet FCR and aFRR requirements. Key activities will include conducting a detailed case study on the installation and operation of the 44MW battery, developing ASDR capabilities, and refining technical requirements to guide future TSO operations. The project will draw insights from European markets and international standards, customising these to Ukraine's unique grid conditions. Collaboration with key stakeholders will ensure that the operating rules are feasible, sustainable, and aligned with the national energy transition goals.	
Action Owner & supporting stakeholders PowerX *Partners needed*: energy storage installers for on-site implementation and research institutions for model validation.	**Next steps** **Partner Identification and Engagement:** Seek collaboration with energy storage installers for on-site implementation and research institutions for model validation. **Technical Feasibility Study:** Conduct preliminary assessments on technical and operational requirements. **Regulatory Engagement:** Establish regular consultations with the TSO and energy regulators to align technical specifications and regulatory frameworks. **Funding Acquisition:** Secure funding for

	both initial setup and operational phases through grants.
Deliverable *Operating rules document*: Detailed guidelines for battery storage systems providing FCR and aFRR services, addressing technical and regulatory standards. *Technical specifications for ASDR terminal*: Comprehensive ASDR terminal design and technical requirements. *Case study report*: Documented findings and best practices from the 44MW battery installation. *Regulatory recommendations*: Insights for policy adaptations to support large-scale BESS integration into Ukraine's energy market.	**Timeframe** *Month 1-2*: Partnership building, feasibility study, and funding acquisition. *Month 3-8*: ASDR terminal development. *Month 9-12*: Drafting operating rules in collaboration with TSO. *Month 6-13* Installation and operational testing of the 44MW battery system. *Month 14-24*: Elaboration of the case study, performance and optimization testing and troubleshooting, finalisation of operating rules drafting.
Policy / Regulatory change required?: No	
Existing funding sources .	**Additional budget required** Additional budget required: 350 000 EUR
Problems # mapping Policy and regulations: 318, 319 Technology adaptation and deployment: 350	**Recommendations # mapping** Policy and regulations: 1.1., 1.7, 1.10, 1.15, 1.16 Human capital: 3.2, 3.6 Ecosystem connectivity: 5.2, 5.5

6.2.22 Development of International cooperation in Energy Transition Policy Lab to exchange experience, knowledge and expertise in the field of energy innovation

<table>
<tr><td>Action Title

Development of International cooperation in Energy Transition Policy Lab to exchange experience, knowledge and expertise in the field of energy innovation</td><td>Action Reference #: UA22

Action status: In progress</td></tr>
<tr><td colspan="2">Action Description
Creation of an international Energy Transition Policy Lab within the framework of the WEnnovate project
International scientific research projects within the framework of scientific and technical cooperation programs
Joint international projects for the implementation of new energy technologies (e.g. Horizon, Post-war reconstruction programs of Ukraine)</td></tr>
<tr><td>Action Owner & supporting stakeholders
Kyiv Academic University with Academ.City project stakeholders
WEnnovate consortium partners</td><td>Next steps
A meeting to discuss the topics of launching international projects for the introduction of new energy technologies</td></tr>
<tr><td>Deliverable
WEnnovate Policy Lab International cooperation unit</td><td>Timeframe
2024 - quarterly sessions
2025 - quarterly sessions</td></tr>
<tr><td>Policy / Regulatory change required?
No</td><td></td></tr>
<tr><td>Existing funding sources
WEnnovate project</td><td>Additional budget required
WEnnovate project next phase</td></tr>
<tr><td>Problems # mapping
Policy and regulations: 318-322, 326, 328, 329, 330
Market state and funding: 341

Lack of resources to restore the destruction of the energy infrastructure as a result of the war. The lag in the creation and implementation of new technologies in energy.</td><td>Recommendations # mapping
Policy and regulations: 1.1, 1.3, 1.7, 1.8, 1.10, 1.13</td></tr>
</table>

Insufficient level of implementation of digital and innovative technologies in the energy sector, the need for access to knowledge and new technologies.	
Indicator / key metrics Number of the international projects and their impact on the energy ecosystem	

6.2.23 Development of digital energy innovations with Digital Innovation Hubs

Action Title Development of digital energy innovations with Digital Innovation Hubs	**Action Reference #: UA23** **Action status:** Planning
Action Description • Development of a digital energy innovations strategy and plan • Scientific programs and projects in the field of implementing information technologies in energy • Development of digital energy innovations (e.g. IoT, AI, blockchain, cloud, data spaces) based on Digital Innovation Hubs (testbeds, services, pilot innovation projects) • Conducting regular hackathons for youth with a focus on developing IT solutions, gamification to address current issues in energy efficiency and sustainable energy solutions.	
Action Owner & supporting stakeholders NOSC-UA DIH, EDIH KyivHitech	**Next steps** 1. Meeting of interested partners, startups together with DIH/EDIHs to discuss strategic and own priorities for digital innovations, exchange experience of digital energy projects 2. Formation of proposals for national Plans on digitalization of energy sector 3. Formation of proposals for DIH/EDIHs hubs regarding the direction of development of services and projects.
Deliverables • Meeting of interested partners, startups together with DIH/EDIHs • Proposals for national Plans for digitalization of energy	**Timeframe** 2024 - preparation stage, digitalization plans 2025 - implementation stage
Policy / Regulatory change required?: No	
Existing funding sources Own resources of DIH/EDIHs	**Additional budget required** Grant for the development of the Action Plan Grants for digital innovation implementation projects
Problems # mapping Policy and regulations: 318, 320, 32, 322, 326, 328, 329, 330	**Recommendations # mapping** Policy and regulations: 1.1, 1.3, 1.7, 1.8, 1.10, 1.13

Absence of a national energy digitization plan consistent with European strategic documents. Insufficient level of implementation of digital and innovative technologies in the energy sector, the need for access to knowledge and new technologies.	
Indicator / key metrics Number of digital energy services DIH/EDIHs The number of implementation projects of digital energy innovations	

7. Monitoring and evaluation of the National Action Plans

Establishing a consistent approach to monitoring and evaluation is essential to ensure accountability, enhance implementation, and maintain the Action Plan's adaptability. This approach will ensure the Plan remains aligned with the EU and all the WEnnovate participant countries' evolving transition needs, as well as the latest scientific developments and international consensus.

While the WEnnovate project is funded only through November 2024, the consortium and relevant third parties are committed to continuing collaboration on the target actions to drive their implementation. Much of this implementation is, however, contingent on securing additional funding, public and private. Potential funding sources have been identified as part of WEnnovate's work and have been considered at both EU and national levels across both D5.2 and D5.3. These sources will be continually updated as new funding opportunities emerge at regional, national, and international levels, and via private channels, supported by efforts to engage new partners for consortium building.

To sustain momentum and ensure progress toward the Action Plan's objectives, the consortium will aim to hold biannual review meetings to assess funding opportunities and report on the implementation status of proposed actions. These meetings will also identify areas for collaborative support. This review process will continue throughout the three-year implementation window targeted by the Action Plan and may be integrated into future consortium management activities if a successor project builds on WEnnovate's work.

Upon formal application for funding—whether for individual actions or the entire Plan—specific key performance indicators (KPIs), evaluation criteria, and benchmarks will be refined and aligned with the Plan's objectives. These metrics will provide a clear framework for assessing success and impact.

The success of the WEnnovate Action Plans will ultimately be measured by the strength of the collaborations formed, the number of projects awarded, and the funding secured as a result of the actions and groundwork prepared in this document and other WEnnovate initiatives.

8. National Action Plans: Conclusion

The digitalization of the energy system is not merely a technical endeavour but a cornerstone of the broader energy transition that intertwines social, digital and clean energy innovations. This action plan, aligning closely with the EU Action Plan for the Digitalisation of the Energy Sector, underscores the importance of fostering both digital and social innovation while engaging the quadruple helix—industry, academia, government, and civil society. It emphasises the central role of local renewable energy initiatives, and robust support for SMEs and innovators, who are pivotal to driving the next phase of Europe's energy transition. By addressing systemic barriers to innovation and adoption, this plan offers a pathway to an inclusive, secure, and sustainable energy ecosystem.

In the current socio-political and geopolitical context, the digital energy transition is more critical than ever. The war in Ukraine, energy security concerns, and global climate imperatives highlight the urgency of creating resilient, decentralised, and efficient energy systems. These efforts must integrate seamlessly with the EU and national strategies to address shared challenges and opportunities across Slovakia, Ukraine, the Netherlands, and Hungary. However, the energy transition cannot succeed by addressing symptoms alone—such as grid inefficiencies or public misconceptions—without tackling the underlying causes, including fragmented governance, insufficient stakeholder engagement, and lack of access to digital tools and resources. By viewing digital and clean energy transitions as mutually reinforcing, this plan advocates for a holistic approach that prioritises long-term sustainability and systemic change.

This action plan calls on stakeholders at all levels to join forces in its implementation. Governments, businesses, research institutions, and communities must collaborate to ensure its recommendations translate into meaningful progress. Together, we can overcome barriers to digital and clean energy adoption, foster trust, and empower local ecosystems to drive innovation. By committing to this shared vision, stakeholders can support the EU's leadership in the global energy transition and ensure a sustainable future for generations to come.

9. National Action plans: Appendices

9.1 Appendix 1: Stakeholder engagement

The WEnnovate project was built upon a process of extensive stakeholder engagement, across all four partner countries, and all components of the quadruple helix. With co-creation at the core of our vision, and the desire to have outcomes that represented the lived experience of a diverse array of stakeholders, not just incumbent players and those representing the status quo, each partner began the project with a thorough mapping exercise of key stakeholders within their ecosystems, this was revised on an ongoing basis. Extensive outreach was conducted and stakeholders were targeted according to their sector experience and ability to provide relevant insights for each stage of the stakeholder engagement process.

The project's stakeholder engagement was guided by a clear methodology, stakeholder dialogue framework (D4.1) and Communication Plan (D4.3). The project initially focused on preliminary and in-depth interviews to define an initial mapping of each of the ecosystems.

As the project moved into its latter stages, a more collaborative approach was taken, favouring workshops, 'policy labs' and international sessions to collectively develop and validate proposed recommendations and actions for these Plans. Surveys were also used as a stakeholder engagement tool however this received less traction across the partner ecosystems so direct engagement was prioritised. Below are the key stats regarding the different stages and formats of engagement throughout the project.

It should be noted that as the national action plans and joint programme are inherently linked and designed in parallel, all stakeholder engagement served as inputs for both final Deliverables and therefore this stakeholder engagement summary is applicable to both Deliverables..

Table 1: High level overview of stakeholder engagement.

Number of stakeholders engaged	408
Number of stakeholder co-creation or co-planning meetings	32
Percentage of engaged stakeholders from underrepresented demographics	37%

Table 2: In-depth interviews participants.

Stakeholder group	Hungary	the Netherlands	Slovakia	Ukraine	Stakeholder group total
Civil society	5	4	6	6	**21**
Government/public authorities	3	4	2	2	**11**
Science/research/innovations	2	2	4	3	**11**
Corporate/business/industry	12	11	11	9	**43**
Country Total	**22**	**21**	**23**	**20**	**86**

Table 3: Workshop participants.

Stakeholder group	Hungary	the Netherlands	Slovakia	Ukraine	Stakeholder group total
Civil society	10	9	9	23	**51**
Government/public authorities	5	16	5	27	**53**
Science/research/innovations	5	5	5	55	**70**
Corporate/business/industry	19	22	12	85	**138**
Country Total	**39**	**52**	**31**	**190**	**312**

Table 4: Policy Lab participants.

Stakeholder group	Hungary	the Netherlands	Slovakia	Ukraine	Stakeholder group total
Civil society	2	1	4	4	**11**
Government/public authorities	1	5	6	3	**15**

Science/research/innovations	3	3	2	7	**15**
Corporate/business/industry	4	3	4	5	**16**
Country Total	**10**	**12**	**16**	**19**	**57**

Table 5: International validation session participants.

EU	Hungary	the Netherlands	Slovakia	Ukraine	Total
4	1	8	5	5	**23**

Table 6: Survey participants.

Stakeholder group	Stakeholder group total
Civil society	**6**
Government/public authorities	**3**
Science/research/innovations	**9**
Corporate/business/industry	**34**
Total	**52**

9.2 Appendix 2: Overview of Slovakia's national context for the digital energy transition

Slovakia is making strides in digitalization across various sectors, including energy, but it faces challenges and remains in an early stage of digital energy transition. Indeed, Slovakia ranks 23rd of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI)[23].

Slovakia's Digital and Energy transition strategic direction

Slovakia has developed several foundational documents to guide its digital transformations:

- Digital Transformation Action Plans (2019-2022, 2023-2026)[24]: These define Slovakia's digitalization goals and are essential for achieving progress across public administration, economic development, and social infrastructure.
- Digital Decade National Plan[25]: Aligned with the EU's 2030 Digital Decade objectives, this plan supports access to digital goods, services, and networks while maximising the digital economy's growth potential.
- 2030 Digital Transformation Strategy[26]: This cross-sector framework envisions Slovakia as a modernised, ecologically focused country that capitalises on data economies, efficient public administration, and enhanced quality of life.

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[23] European Commission. (2022). Digital Economy and Society Index (DESI) 2022 | Shaping Europe's digital future. Digital-Strategy.ec.europa.eu. https://digital-strategy.ec.europa.eu/en/library/digital-economy-and-society-index-desi-2022

[24] Slovenská republika. (2023). Akčný plán digitálnej transformácie Slovenska na roky 2023 – 2026 [PDF]. Ministerstvo investícií, regionálneho rozvoja a informatizácie Slovenskej republiky. Retrieved from https://ppl-ai-file-upload.s3.amazonaws.com/web/direct-files/35342964/e036cfa9-9323-46e8-b7ae-865a894ec5cc/APDTS-2023-2026.pdf

[25] Vnútroštátny plán Digitálnej dekády Slovenskej republiky. (2022). Ministerstvo investícií, regionálneho rozvoja a informatizácie Slovenskej republiky. https://ppl-ai-file-upload.s3.amazonaws.com/web/direct-files/35342964/f17ddc00-c479-4bf4-84f0-3766714859eb/Vnutrostatny-plan-Digitalnej-dekady-za-Slovensku-republiku-1.pdf

[26] Jakobsone, M. (2022). Slovakia - 2030 Digital Transformation Strategy | Digital Skills and Jobs Platform. Digital-Skills-Jobs.europa.eu. https://digital-skills-jobs.europa.eu/en/actions/national-initiatives/national-strategies/slovakia-2030-digital-transformation-strategy

Next to those, Slovakia has also published a number of energy transition frameworks:

- National Recovery and Resilience Plan[27] (NRRP): Allocating €6.4 billion, the NRRP includes provisions for low-carbon technology development, renewable energy deployment, sustainable transportation, and energy efficiency. Its RePowerEU chapter emphasises the green transition, dedicating nearly half of funds to renewables, sustainable transport, and green skills development.
- National Energy and Climate Plan[28] (NECP): This strategic document outlines Slovakia's contributions to EU climate targets. Although it faces criticism for lacking detail and ambition, it sets foundational goals for energy security, emissions reduction, and renewable energy adoption.
- Other Strategies and Policies: These include the Slovak Energy Policy, Low-carbon Development Strategy (up to 2050), Enviro-strategy 2030, and the 2021-2027 Program for EU funds, all of which provide a framework for green initiatives, efficiency improvements, and climate-neutral ambitions.

Despite Slovakia's array of digitalization and energy transition strategies, it currently lacks an integrated framework that connects digital transformation with energy transition, or "digital energy." While the country has developed several foundational documents for digitalization, including the Digital Transformation Action Plans, the Digital Decade National Plan, and the 2030 Digital Transformation Strategy, these efforts are largely focused on individual sectors without a cohesive strategy for how digital advancements can directly support energy transition goals. Similarly, Slovakia's energy transition frameworks, such as the National Recovery and Resilience Plan, the National Energy and Climate Plan, and the Slovak Energy Policy, emphasise renewables, efficiency, and sustainability but stop short of specifying how digital technologies can enhance these objectives. Establishing a comprehensive digital energy framework would bridge this gap, enabling Slovakia to capitalise on synergies between digital and energy sectors. Such an approach could accelerate grid modernization, renewable integration, and energy efficiency, positioning Slovakia to make more effective use of its digital and green investments.

Digital transformation

Overall, Slovakia's roadmap outlines a substantial commitment to achieving the EU's Digital Decade goals, setting targets for 12 of 14 key performance indicators (KPIs), mostly aligned with the EU's 2030 ambitions. One exception is digital skills, where Slovakia falls short of EU targets. In 2024, the country

[27] European Commission. (2023). Slovakia's recovery and resilience plan. https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility/country-pages/slovakias-recovery-and-resilience-plan_en

[28] Slovak Ministry of Economy (2019). Integrated National Energy and Climate Plan for 2021 to 2030.

plans to allocate over EUR 2.3 billion (1.8% of GDP) toward advancing digital transformation, excluding private investments[29].

Despite some recent improvements, particularly in connectivity and coverage, Slovakia's progress in digitalisation remains below the EU average. To bridge this gap, national strategies emphasise the need to enhance digital skills for all age groups—from students to adults—enabling the population to meet the demands of a more digitalized society. Without this, the digital skills gap will significantly hinder Slovakia's efforts in advancing the digital energy transition.

Energy Mix

The Slovakian energy system is characterised by a diverse mix of energy sources, including nuclear power, oil, natural gas, coal, biofuels, and hydro. However, Slovakia relies heavily on net energy imports, which make up 68% of its energy supply, with fossil fuels continuing to play a significant role in the total energy supply (the sum of all energy produced domestically or imported, minus exports and stored energy). Nuclear energy remains the largest contributor, accounting for 25% of the energy mix, followed closely by oil at 24% and natural gas at 23%[30].

Domestically, nuclear energy dominates as Slovakia's primary source of energy production, contributing approximately 59%, followed by biofuels and waste at around 29%. Other sources, such as hydro, oil, and natural gas, each contribute less than 5% to domestic production, whilst Slovakia ended its domestic production of coal in 2024.. Notably, Slovakia has one of the lowest shares of wind and solar energy in the EU. In electricity generation, hydro plays a notable role as the second-largest source, representing about 14% of electricity generated, with nuclear leading at 60%.

Slovakia remains significantly dependent on third countries for its primary energy sources, with Russia historically serving as the main supplier of both fossil fuel imports and nuclear fuel. In 2022, nearly 100% of Slovakia's natural gas, oil, and nuclear fuel, along with approximately 33% of its coal imports, came from Russia. While efforts to diversify fossil fuel imports are underway—including replacing roughly 33% of Russian natural gas following the Russian invasion of Ukraine—dependency on Russian nuclear fuel and oil remains substantial).

Renewable Energy regulatory history

A key factor in Slovakia's slow adoption of renewable energy was a prolonged ban on connecting new electricity generators to the national grid, which lasted nearly a decade and only lifted in 2021. Following

[29] International Trade Administration. (2024, September 20). Slovakia - Digital Economy. International Trade Administration | Trade.gov. https://www.trade.gov/country-commercial-guides/slovakia-digital-economy

[30] IEA. (2024). Slovak Republic - Countries & Regions. IEA. https://www.iea.org/countries/slovak-republic

the 2010 introduction of the Act on Renewable Energy Sources, Slovakia initially experienced growth in renewable installations, particularly in photovoltaic (PV) systems. This Act provided support through measures like grid access, mandatory electricity purchases, feed-in tariffs, and imbalance settlement by the Transmission System Operator (TSO). However, much of this government-backed support was withdrawn by mid-2011, resulting in a decade-long stagnation in non-hydro renewable installations, with the TSO attributing the slowdown to inadequate grid capacity for new connections (source).

This restrictive period ended in 2021 with the opening of a new interconnector line to Hungary, which has since revived interest in renewable energy system (RES) installations. The high level of demand in this sector was evident in 2021 when the Slovak Innovation and Energy Agency (SIEA) allocated EUR 700,000 in funding for small-scale, non-grid-connected PV systems, all within 30 minutes. While this recent progress is promising, the long delay has had a lasting impact on Slovakia's renewable energy sector and digital energy transition efforts (source).

Digitalisation of the energy sector progress

The digitalization of Slovakia's energy sector remains in its early stages, facing several challenges. The adoption of Energy Management Systems (EMS) and Internet of Things (IoT) solutions at both commercial and residential levels has been slow. This slow uptake is reflective of the broader digital maturity issues within Slovakia's small and medium-sized enterprises (SMEs), which often lack the necessary support and resources for advanced digital transformations. The state of the electrical grid also underscores the need for modernization to better integrate digital solutions - whilst efforts are being made to improve the infrastructure and ease of access for renewables, progress is gradual. Additionally, the penetration of e-mobility infrastructure, such as electric vehicle (EV) charging stations, is low, hindering the adoption of electric vehicles within the country).

Despite these challenges, there are positive steps being taken. It should be noted that in June 2024 SEPS, Slovakia's TSO, received €83 million from the Recovery and Resilience Plan to modernise and digitise the grid via the construction of a new power station and modernization of high voltage lines. This will support the capacity of the transmission system and the grid's ability to cope with the changing source mix in Slovakia's electricity production. Additionally, Slovakia is aligning with European digital energy initiatives to support grid performance, with the recent successful launch of the local operation of the MARI and PICASSO projects which will support grid balancing via the cross-border energy community. Beyond grid capacity, the introduction of Energy Data Centers (EDC) aims to centralise and streamline energy data, which can enhance efficiency and enable better management of energy resources.

Digital energy transition support

In this landscape, agencies like the Slovak Innovation and Energy Agency (SIEA) play a pivotal role as delivery bodies, bridging the gap between policy formulation and practical implementation. By allocating resources and managing projects directly, SIEA ensures that the ambitious frameworks laid

out in national strategies translate into tangible outcomes. Their focus on fostering innovation, supporting renewable energy projects, and facilitating access to funding helps overcome the significant challenges associated with the energy transition. As Slovakia navigates its digital energy landscape, it is crucial to allocate sufficient resources to such agencies, empowering them to execute essential initiatives that can drive progress and build a sustainable energy future.

While the country has made commendable strides in digitalization and has laid out comprehensive frameworks for energy transition, the lack of an integrated strategy that connects these two domains hampers its progress. To realise its ambitious goals, Slovakia must prioritise the development of a cohesive digital energy framework that leverages synergies between digital technologies and renewable energy initiatives. This integration is essential for enhancing energy efficiency, modernising infrastructure, and fostering sustainable growth. Furthermore, empowering agencies like the SIEA with adequate resources will be vital in translating strategic plans into actionable projects that can drive meaningful change. By addressing gaps in digital skills and fostering collaboration among stakeholders, Slovakia can strengthen its position in the European landscape and pave the way for a resilient, sustainable, and digitally advanced energy sector.

9.3 Appendix 3: Slovak National Funding resources

1. Joint Cluster Initiatives (EUROCLUSTERS) for Europe's recovery

Goal: Europe's ambitions for both climate neutrality and digital leadership.

- **Funding:** Maximum EUR 2 625 000 per project.
- **Conditions:**
    - 25% of the budget: joint activities between cluster organisations.
    - 75% of the budget: directed to SMEs in the form of financial support to third parties.
- **Eligibility:**
    - Minimum three cluster organisations or cluster networks from at least three different EU Member States
    - At least half of the partners in each consortium (Eurocluster) must be cluster organisations or cluster networks registered or having submitted a registration on the ECCP
    - At least one partner established in a less advanced region
    - Proposals must be focused on only one of the two strands of this call for proposals:
        - Strand 1: net-zero technologies and critical raw materials
        - Strand 2: value chains not covered in Strand 1
- **Deadline:** 5 February 2025 – 17:00:00 CET
    - At least half of the partners in each consortium (Eurocluster) must be cluster organisations or cluster networks registered or having submitted a registration on the ECCP

2. Fund for Bilateral Relations (FBR03)

Goal: Enhance cooperation and improve mutual knowledge and understanding between Slovakia and the Donor States – Norway, Iceland and Liechtenstein.

- **Funding:** EUR 70,000 for smaller-scale bilateral events, EUR 300,000 for bigger, strategic bilateral initiatives
- **Conditions:**
    - No co-financing is requested by the applicants
- **Eligibility:**

  - All legal entities established in Slovakia or in one of the Donor States are eligible applicants and partners.
  - An international organisation can be an applicant or a partner, as long as there is a Slovak and a Donor State entity involved in the initiative as an applicant or as a partner.
  - The number of partners is limited to four.
- **Deadline:** 31 December 2024

3. Category: Challenge I4: Support for the development of innovative solutions in the field of decarbonization No. 2

Goal: support innovation in enterprises through the development (activities carried out in the part of the research and innovation cycle that corresponds to higher levels of technological readiness) of unique solutions in the field of decarbonization

- **Funding:** Depends on the size of the company.
  - Small company: 45 % maximum aid intensity for the project / 60% when eligible for an increased rate of maximum aid intensity
  - Medium company: 35 % maximum aid intensity for the project / 50% when eligible for an increased rate of maximum aid intensity
  - Large company: 25 % maximum aid intensity for the project / 40% when eligible for an increased rate of maximum aid intensity
- **Themes:**
  - Climate science and addressing climate change
  - Carbon-free energy (energy – storage, supply, energy networks and systems)
  - Electrification
  - Hydrogen, battery technologies and alternative fuels
  - Clean, safe, accessible and intelligent transport and mobility
  - Low-emission industrial processes and materials
  - Bioeconomy, sustainable agriculture and forestry
- **Deadline:** 31 December 2024

4. Other available sources of funding

- **Just Transition Fund**
  - Slovakia's Territorial Just Transition Plan for 2021-2027 highlights three key pillars addressing the needs and priorities of coal-dependent regions. The first focuses on economic diversification by fostering the growth of new businesses. The second emphasizes clean energy transition and brownfield revitalization, which includes expanding solar and geothermal energy, enhancing energy efficiency in public buildings, investing in brownfield redevelopment, and promoting smart, sustainable transport solutions such as small-scale hydrogen mobility pilot projects. The third pillar

centers on reskilling and retraining programs to support workers in adapting to new economic opportunities[31].

- **Cohesion Fund** and **European Regional Development Fund:**
    - Slovakia will receive €4.2 billion from the European Regional Development Fund (ERDF) and the Cohesion Fund to support its climate goals and reduce reliance on Russian energy. The funding will boost the use of renewable energy sources, lower final energy consumption, and cut greenhouse gas emissions in public buildings[32].
- **Recovery and Resilience Facility (NextGenerationEU fund)**
    - Slovakia's Recovery and Resilience Plan includes 196 "mutually agreed deliverables," comprising qualitative milestones and quantitative targets to monitor the progress of reforms and investments under the plan. It is backed by €6.4 billion in grants, with 43% allocated to climate-related objectives and 21% dedicated to advancing the digital transition. Energy communities benefit indirectly through reforms and investments outlined in the REPowerEU chapter[33].
- **European Social Fund Plus**
    - The EU is allocating EUR 2.35 billion through ESF+ funds to Slovakia to support sustainable employment and foster a more inclusive and digitally adaptable labor market. These funds will enable workers to upskill and reskill, equipping them to meet the evolving demands of the modern workforce[34].

[31] Patriciolo, C. (2024, February 7). Slovakia's regional coal phase-out to be an example for other coal regions in Europe - CEENERGYNEWS. Ceenergynews.com. https://ceenergynews.com/climate/slovakias-regional-coal-phase-out-to-be-an-example-for-other-coal-regions-in-europe/

[32] European Commission. (2024). EU Cohesion Policy: Commission adopts €12.8 billion Partnership Agreement with Slovakia for 2021-2027. European Commission - European Commission. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_4510

[33] Rescoop. (2024). Slovakia - Recovery & Resilience Fund - REScoop. Rescoop.eu. https://www.rescoop.eu/policy/financing-tracker/recovery-resilience-funds/slovakia-recovery-resilience-funds

[34] European Commission. (2024b, October 17). The ESF+ in Slovakia | European Social Fund Plus. Europa.eu. https://european-social-fund-plus.ec.europa.eu/en/support-your-country/esf-slovakia

9.4 Appendix 4: Hungarian national and EU level calls and funding opportunities

1. DIMOP PLUSZ 1.1.2.A-24 - Support for Digital Product Innovation Development

Goal: Support the market entry of innovative digital products and services.

- **Funding:** Non-refundable grants between HUF 10-35 million.
- **Conditions:**
  - Applicants must provide at least 30% own contribution.
  - Project costs cannot exceed last year's revenue; grant amount cannot exceed last year's equity.
  - Advance payment: 25%.
- **Eligibility:**
  - Hungarian entities (registered headquarters, branch, or office).
  - Micro and small enterprises with double-entry bookkeeping.
  - Minimum of three employees and at least two closed financial years.
- **Technologies Supported:**
  - Artificial Intelligence, Big Data, 5G/6G, IoT, VR/AR/MR, blockchain, quantum computing, cloud technologies, and new-generation software development.
- **Submission Window:** December 2024 - February 2025.

2. EIC Accelerator

Goal: Support innovative, high-risk projects with fast growth potential for new products, technologies, services, or business models.

- **Scope:** Open to innovations across all technological and application fields.
- **Eligibility:**
  - Startups, SMEs, and small mid-caps (up to 500 employees) from EU member states or Horizon Europe Associated Countries.

3. AI REGIO Open Call

Goal: Select up to 10 experiments led by SMEs focusing on AI applications and Industry 5.0 to enhance manufacturing processes, products, or solutions.

- **Funding:** Maximum EUR 60,000 per experiment, covering:
    - 60% of eligible costs for SMEs or for-profit entities.
    - 100% of costs for non-profit organisations.
- **Focus Areas:**
    - AI-at-the-Edge: Convergence of AI, Cloud, Edge, and IoT technologies.
    - Applications include predictive maintenance, automation, energy efficiency, and waste reduction.
- **Eligibility:** Manufacturing SMEs supported under the Horizon Europe framework.

These opportunities are tailored to foster digital and AI innovation in businesses, particularly SMEs, driving progress in energy efficiency, digitalisation, and advanced manufacturing technologies.

Additional EU level funding calls:

HORIZON-CL5-2024-D3-02-10: Market Uptake Measures of renewable energy systems
HORIZON-CL5-2024-D4-02: Efficient, sustainable and inclusive energy use
HORIZON-CL5-2025-02-D3-16: Support to the SET Plan stakeholder fora
HORIZON-EIE-2025-02-CONNECT-02: Implementing co-funded action plans for connected regional innovation valleys

9.5 Appendix 5: List of WEnnovate deliverables referenced

Document	Source
D3.1: 4 National Deeptech Ecosystem Maps	Link
D3.2: Report of needs, problems, and obstacles in countries-participants	Link
D.5.1: List of Recommendations for the Action Plan with Buy-in from Stakeholder Dialogue	Link
D5.3 Joint long-term programme plan (incl. Resource and Activity allocation plan)	Link


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